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Space Transportation System Biomedical Operations Support Study

**Stanley C. White, M.D., M. P. H.
The Bionetics Corporation**

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National Aeronautics and
Space Administration

John F. Kennedy Space Center




SPACE TRANSPORTATION SYSTEM
BIOMEDICAL OPERATIONS SUPPORT STUDY

Study conducted by
The Bionetics Corporation
for the
Biomedical Office
John F. Kennedy Space Center

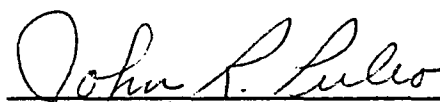
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GLOSSARY OF TERMS, ABBREVIATIONS AND ACRONYMS

TERMS

American Accreditation Association for Laboratory Animal Care	A voluntary association that sets standards, inspects and certifies adequacy of facilities, policies, personnel and practices in vivaria that house and provide animals for research experimentation.
Assistant for Bioastronautics	The medical staff officer of the DOD DDMS.
Baseline Data Collection Facility	Human life sciences experiment support facility.
Biomedical Office	KSC staff office that manages the medical, operations, occupational and environmental health programs for the Center.
Emergency Medical Support System	That part of the medical operations program devoted to the emergency care of the crew, supporting personnel, or visitors, that may become injured or ill during flight operations.
Flight Operations	Any portion of the flight scenario that prepares for flight, occurs during flight, landing or postlanding that is part of the mission.
Hangar L	Facility housing the Life Sciences Support Facility (LSSF) that will provide KSC support for non-human life sciences experiments.
Health Stabilization Program	Formal program to limit or prevent exposure of crew members to disease prior to a flight.
Launch Operations	The activities surrounding the countdown that lead to a launch of the vehicle.
Medical Operations	The part of the overall KSC medical program that directly supports the flight operation (crew care and support, launch and landing support, postlanding support, life sciences research experiment support).

Mission Commander	Senior crew member for each mission.
Mission Specialist	Crew member responsible for the overall payload operation and engineering management for a mission.
NASA Director of at Life Sciences	Senior Life Sciences staff office NASA Headquarters in Washington, D.C.
Occupational Medicine and Environmental Health System Program	The part of the overall KSC medical program that provides medical care for the government and contractor personnel while on the job.
Operational Status	Routine flight status, flight on a routine basis.
Payload Specialist	Crew member assigned as technical expert for the spaceflight payload on each mission.
Pilot	Second astronaut crew member for each mission.
Space Shuttle/Shuttle	Space Transportation Systems (STS) orbiter; missions are numbered consecutively - STS-1, STS-2, STS-3, etc.

ABBREVIATIONS

ASAP	As Soon As Possible
R & D	Research & Development
USSR	Union of Soviet Socialist Republics
VIP	Very Important Persons

ACRONYMS

AAALAC	American Accreditation Association for Laboratory Animals
ARC	Ames Research Center, California
BDCF	Baseline Data Collection Facility
BOC	Base Operations Contract
BOSU	Bioastronautics Operations Support Unit
CAD	Computer Aided Diagnosis
CAP	College of American Pathologists
CCAFS	Cape Canaveral Air Force Station, Florida
DDMS	Department of Defense Manager for Shuttle Support
DDT&E	Design, Development, Test and Evaluation
DOD	Department of Defense
ELV	Expendable Launch Vehicle
EMSS	Emergency Medical Support System
HHS	Department of Health and Human Services
IRF	Intramural Research Facility
JPL	Jet Propulsion Laboratory, California
JSC	Lyndon B. Johnson Space Center, Texas
KSC	John F. Kennedy Space Center, Florida
LCC	Launch Control Center
LSSF	Life Sciences Support Facility
MCC	Mission Control Center
MD	Biomedical Office
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NMI	NASA Management Instruction
NSF	National Science Foundation

O & C	Operations and Checkout Building
OMEHS	Occupational Medicine and Environmental Health System
PAO	Public Affairs Office
POCC	Payload Operation Control Center
RDT&E	Research, Development, Test and Evaluation
RTOP	Research Technical Objective Plan
SCAPE	Self Contained Atmospheric Protective Ensemble
SLF	Shuttle Landing Facility
STS	Space Transportation System
USAF	United States Air Force
VAFB	Vandenberg Air Force Base, California
VIC	Visitors Information Center

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A study that seeks to project for the future must draw upon the experience and expertise of the many who participated in the evolution of manned spaceflight if it is to be successful. This is the course that was followed and I believe the product was greatly enhanced by the open and free discussions that were given during the preparation of the data base that was used in preparing the report. Special appreciation for their ideas, suggestions, and time is extended to the life sciences and medical staff members at the National Aeronautics and Space Administration (NASA) Headquarters, at John F. Kennedy Space Center (KSC), at Ames Research Center (ARC), and the Jet Propulsion Laboratory (JPL). The informal discussions with the life sciences and medical staff members at the Lyndon B. Johnson Space Center (JSC) gave insight into their thinking for the "operational shuttle" even though their plans have not reached a state of maturity that they wished to announce formally. Discussions with the Department of Defense Manager for Shuttle Support (DDMS)/Assistant for Bioastronautics and the Commander and staff of the Aerospace Medical Division, Air Force Systems Command provided excellent insight into how and where the Department of Defense (DOD) life sciences research and medical operational programs are going. Their inputs have been synthesized into what is hopefully a cohesive recommended posture and future actions for KSC life sciences and medical operations for the operational Space Transportation System (STS).

Section 7 of this report develops a suggested list of facility requirements for life sciences research, medical operations and STS experiment support that

will be needed at KSC in the maturation of KSC into Spaceport (East). The specific requirements are contained in the individual sheets contained in Appendix A. The generation of the detail on these drew upon the experience and expertise of the people listed alphabetically below:

Roger L. Blair, B.S.

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EXECUTIVE SUMMARY

SPACE TRANSPORTATION SYSTEM BIOMEDICAL OPERATIONS SUPPORT STUDY

The transition of the STS program from design, development, test and evaluation (DDT&E) to operational status represents a major milestone in the maturation of the STS flight operations and for the medical efforts supporting the program. It also represents a major milestone for the NASA because the STS is the first major flight program that NASA has carried into operational status. To successfully meet the flight schedule of the STS, the KSC must rapidly make this transition and shift its overall management philosophy of providing individual support for each flight program to one of becoming a general spaceport that will be able to meet the changing needs of all future manned spaceflight activities, including the STS program. As a result, the KSC senior management can be expected to request the development of facilities and to institute changes in its operational policies and procedures that will be needed to meet the future dynamic situation that will prevail during STS flight operations and beyond.

Planning for the medical operations and the support of the life sciences experiments during this new era must be equally innovative, dynamic, and flexible. Lessons will continue to be learned with each flight that will influence the content and the structure of the final medical operations and life sciences experiment support programs.

Examples of the dynamics of the flight situation that can be expected to impact the medical and experiment support efforts include: a) the increasing frequency of launches and the addition of landings at KSC will affect the amount and schedule of medical resources committed to each flight and will probably require a dedicated medical team to cover the launch and landing operation; b) each addition of a new orbiter will require a period of "shakedown" and learning about the vehicle during its initial flights; c) increasing number of crew members per mission can be expected and will require the availability of more medical support during visits preflight to KSC as well as during the period surrounding the actual flight operation; d) missions can be expected to be of longer duration and include more experiments including life sciences to fill the longer missions; e) more experiments can be expected to result in increased periods of time for the crewmen at KSC during their preparation, integration, and checkout; f) Department of Defense (DOD) participation will increase in all medical aspects of flight operations and in the sponsorship of life sciences experiments which will directly require increased support from the KSC biomedical facilities; g) as the flight operations become more repetitive and routine, it can be expected that the KSC Biomedical Office (MD) will to be asked to assume more of the repetitive activities for each flight; h) accomplishment of the ambitious schedule of flights can be expected to place a special long-termed stress load upon the NASA and contractor ground based work force at KSC.

To meet the above exciting and complex challenges, it is recommended that the KSC Biomedical Office establish a management posture of a willingness to accept all elements of the routine STS medical and life sciences work load that the lead NASA Centers (JSC and ARC) and the DOD are willing to assign to

KSC for accomplishment. This position is easy to establish but much more difficult to achieve, especially when one recognizes the lack of details on what and when these requirements will be levied upon KSC. If the KSC Biomedical Office is to make a smooth and efficient transition to the operational era it is important to clarify the following tasks and opportunities: a) how many crewmen will be at KSC and for what periods of time prior to each flight? b) will all or part of the crew pool eventually move to the KSC area? c) what are the JSC long-range plans and goals as far as providing or requesting KSC to provide aerospace medicine care for the crews when they are at KSC? d) what are JSC and DOD long-range plans for providing their personnel and resources at KSC for the support of STS flight medical operations and flight experiments that will use human testing? e) what will be the overall requirements for medical and human experiment support facilities to be used in the support of research investigators while they are at KSC? f) what will be the overall size of the KSC NASA and contractor work force to meet the intensive program for recycling the STS vehicles and preparing the payloads to meet the flight schedule? g) what will be the long-ranged ability and the willingness of the local KSC medical community to continue to provide support for the launches and landings at KSC when the flight frequency averages one per month? If KSC is to successfully become an operating Spaceport (East) it must be able to provide the medical support required to successfully meet all of these issues.

The intramural life sciences research program at KSC also has arrived at an important point of transition. Over the past years it has slowly evolved and matured and is now recognized in several areas of expertise. It has now achieved sufficient size and capability that causes the question to be asked,

"Shall it remain at its current level and scope or should it be allowed to continue to broaden and add research that will address issues of a more general NASA interest while continuing to respond to the issues of local KSC concern?" In deciding upon the course to follow for the intramural research program, the Biomedical Office must recognize that it already is preparing to provide more medical flight operations and life sciences experiment support for the STS program and can be expected to be asked to address increasingly complex KSC stress, physiology, and environmental questions in its intramural program regardless of the final chosen course. The preparation to accomplish all of this will bring with it, as a product of serendipity, the basic tools for the conduct of a much broader research program - the research facilities, the availability of time in the facility to conduct additional research, a professional staff and expertise to conduct the work, and an abundance of research ideas of local KSC and NASA interest. It should also be noted that there is an ongoing operational cost for maintaining these facilities to support the STS missions. The intramural research program provides an excellent base for gaining a good return on this investment if a larger and continuing research program is implemented. Relatively small additional amounts of research funds would be required to obtain a major increase in research results since a part of the overhead will have already been paid just to keep the facilities ready for STS needs.

To assist the KSC in the address of its needs for becoming a mature spaceport an analysis was made as to what medical and life sciences facilities would be required. Current facilities have evolved and have been built individually as each specific requirement has been identified. The result has been separate, crowded, space-limited facilities and in many cases less than efficient

operations. The initial analysis examined what the projected facility needs would be if the current unit per unit construction approach was followed to meet the STS and follow-on programs. The second phase of the analysis looked at what might be gained through consolidation, collocation, and cross utilization of these facilities. Major reductions in overall space requirements were identified that would result in savings of the cost of construction. The integrated approach will also permit a more efficient use of the facilities and the time of the crew and the staff. It should also permit obtaining the maximum results with the minimum number of personnel, a major continuing cost.

Section 4 summarizes what is projected for the operational flight program of the STS and the biomedical impact that it may impose. Section 5 analyzes the elements of the medical programs in view of the flight operations discussed in Section 4. Section 6 examines the intramural research opportunities for NASA and particularly as they may apply to KSC. Specific conclusions and recommendations are included for NASA consideration at the end of each area of discussion of Section 5 and at the end of Sections 4, 6, and 7. Section 7 summarizes the suggested overall space requirements and capabilities that are projected to be needed for the conduct of flight medical operations, the support of human flight experiments, and the conduct of a vigorous intramural research program at KSC as Spaceport (East) matures. A summary of these requirements are contained in Table 3 in Section 7. Section 8 provides a listing of the documentation reviewed in developing the background and data base for the preparation of this report.

For the convenience of the reader the major conclusions and recommendations that are discussed in detail at the end of Sections 4, 6, 7, and at the end of each area in Section 5 have been summarized in Charts 1, 2, 3, and 4 that follow here. These charts also contain an abridged discussion of the importance and potential impact that the conclusions and recommendations may have for the KSC Biomedical Office. The reader is referred to the detailed discussion in the main text of the report as a means of amplifying or understanding the rationale that led to the conclusions and recommendations contained in the charts.

The study has applied the accumulated medical and life sciences experience with manned spaceflight to what is projected to be needed for the future for the STS program as it exists today and is expected to be needed when the STS program matures. It provides a series of conclusions and recommendations that are made to lead the KSC Biomedical Office through the transition into the operational era of KSC Spaceport (East). Many additional studies, position papers, and negotiations must be made before final decisions by NASA can be made. Many of the recommendations have been based upon best projections since the details on the elements of the program have not been completed. The program is expected to continue through many dynamic changes. The key to success for the medical and life sciences efforts is a recognition of the dynamic nature of the shuttle program and maintaining the ability to remain flexible in the planning and program execution to meet the changes that will come.

Chart 1. A SUMMARY OF MEDICAL IMPACT OF SHUTTLE FLIGHT PROGRAM

	1983	AFTER 1983
LAUNCH FREQUENCY	FLIGHT INTERVAL 1 FLIGHT / 3 MONTHS 4 FLIGHTS / YEAR	FLIGHT INTERVAL 1 FLIGHT /MONTH (MIN = 0.5 MO; MAX 1.5 MO.) LAUNCH FREQUENCY WILL REQUIRE DEDICATED MEDICAL OPERATIONS SUPPORT TEAM.
LANDING AT KSC	STS-7 INITIATION	ROUTINE AFTER STS-9 (OCTOBER 1983)
MISSION DURATION	5-7 DAYS MIN - 3 DAYS; MAX - 9 DAYS (STS-9)	5 - 7 DAYS AVERAGE; EX- PECT MISSION EXTENSIONS (AS WAS DONE ON STS-9) WITH ADDED FLIGHT EXPE- RIENCE AND/OR DELAY IN DECISION ON SPACE STATION. MISSION EXTENSION TO 2 WEEKS OR 3 WEEKS NOT UN- REALISTIC. 4 WEEK MISSION EXPECTED TO BE MAXIMUM MISSION FOR STS.
CREW SIZE	4-7 CREW MEMBERS ALL NASA SELECTED	4 - 7 CREW MEMBERS. ANTICIPATE ADDITIONAL MIS- SION AND PAYLOAD SPECIALISTS TO BE ADDED. BE PREPARED FOR POSSIBLE ADDITION OF NON-MISSION RELATED PASSENGERS.
CREW SUPPORT	PROGRESSIVELY MORE IN- VOLVEMENT OF KSC BIO- MEDICAL OFFICE IN CREW SUPPORT	KSC WILL HANDLE LAUNCH AND LANDING RELATED MEDI- CAL CARE AND OPERATIONS AND HUMAN EXPERIMENT SUPPORT. EXPECT REQUEST FOR INCREASED CREW CARE WHILE AT KSC FOR CREW MEMBERS BETWEEN MISSIONS.

Chart 1. (page 2 of 3)

VISITORS AT FLIGHT
EVENTS

THROUGH STS-9/FLIGHT
30,000-40,000 VISITORS
5,000-6,000 VIP VISITORS
1,500-2,000 PRESS

BEYOND STS-9 15,000-
20,000 VISITORS 1,000
VIP VISITORS 500-700
PRESS

NEGOTIABLE - VISITORS
INTEREST WILL DROP OFF
AFTER STS-9. 1,000-
1,500 VIPS AND PRESS

ASSIGNMENTS OF UNUSED
VIEWING SITES TO CONTRAC-
TOR FOR KSC VISITORS IN-
FORMATION CENTER.

DOD PARTICIPATION

TO BE DEFINED AS TO
NUMBERS OF PERSONNEL
SKILLS/FACILITIES THAT
WILL BE AVAILABLE FOR
EACH FLIGHT BEYOND THAT
REQUESTED FOR TRAINING
AND GAINING EXPERIENCE
BY DOD.

TO BE DEFINED AS TO ROLE
AND RESOURCES AVAILABLE/
FLIGHT. TRAINING AND
EXPERIENCE SOUGHT BY DOD
PERSONNEL IN PREPARATION
FOR DOD OPERATION AT VAFB
(MID 1985). AMBITIOUS
"CARRY-ON" MID-DECK EXPER-
IMENT PROGRAMS WILL BE
CONDUCTED. REQUEST FOR
EXPERIMENT SUPPORT SHOULD
BE EXPECTED BY KSC.

EXPENDABLE LAUNCH
VEHICLES

8-11/YEAR

8-11/YEAR THROUGH MID-
1986. AFTER MID-1984
EXPECT THESE OPPORTUNITIES
TO BE SHIFTED TO SHUTTLE
RATHER THAN ELV. SOME
LAUNCHES MAY BE GIVEN TO
PRIVATE INDUSTRY.

Chart 1. (Page 3 of 3)

SPACEPORT (EAST)
(OPERATIONAL SHUTTLE)

USE PERIOD BETWEEN STS-6 AND 9 AS TRANSITION PERIOD FOR MEDICAL OPERATIONS. HAVE OPERATIONS CONFIGURATION PLANS COMPLETED BY END OF STS-9. IMPLEMENT OPERATIONAL MEDICAL PLAN ASAP AFTER STS-9.

THERE WILL BE LIMITED SUPPORT REQUIRED FOR LIFE SCIENCES FLIGHT RESEARCH EFFORTS DURING STS-6 THROUGH STS-9. EXPECT INCREASED NUMBER OF CARRY-ON EXPERIMENTS TO BE PLANNED, ESPECIALLY FOR OPERATIONAL QUESTIONS, i.e., "SPACE SICKNESS" AREA. STS-9 (SPACELAB 1) OFFERS FIRST OPPORTUNITY TO EXERCISE KSC LSSF. STUDENT EXPERIMENT SUPPORT WILL CONTINUE.

INITIATE PLANNING FOR LONG TERMED MEDICAL AND LIFE SCIENCES NEEDS AT KSC TO MAKE KSC - SPACEPORT (EAST). IN PLANNING, ACCEPT PRESENT OPERATIONAL PROVISIONS AS INITIAL REQUIREMENTS. DRIVE PLANNING TOWARD LOOKING FOR A PERMANENT SOLUTION TO FUTURE NEEDS AT KSC.

MEDICAL OPERATIONS PROGRAMS WILL BE "TWEAKED" FOR IMPROVED EFFICIENCY. KSC PARTICIPATION IN MEDICAL OPERATIONS WILL BE LIMITED ONLY BY KSC ABILITY AND WILLINGNESS TO PERFORM EFFORT.

DEDICATED LIFE SCIENCES PAYLOAD SUPPORT EVERY 18-24 MONTHS AND FREQUENT, MULTIPLE MID-DECK AND CARRY-ON PAYLOADS WILL REQUIRE SUPPORT ON MISSIONS BETWEEN DEDICATED MISSIONS. SUPPORTING DOD CARRY-ON, MID-DECK EXPERIMENTS WILL MARKEDLY INCREASE. STUDENT EXPERIMENTS SUPPORT CONTINUES, HOWEVER, KSC MAY HAVE TO PROVIDE MORE EXPERTISE FOR STUDENT EXPERIMENTER.

COMPLETE AND EXTEND MEDICAL PLANNING TO REFLECT LONG TERM NEEDS OF NASA AND PROGRAMS TO BE DONE AT KSC. DEVELOP DECISIONS WITH KSC MANAGEMENT, NASA HEADQUARTERS, OTHER KEY NASA CENTERS AND PROGRAM OFFICES TO ENSURE THAT LONG TERMED PLANNING FOR KSC MEETS WHAT NASA WILL NEED AND CAN BE PROVIDED AT KSC.

Chart 2. SUMMARY CONCLUSIONS AND RECOMMENDATIONS FROM SECTION 5,

BIOMEDICAL IMPACT OF THE FUTURE FLIGHT OPERATIONS

THE KSC EMERGENCY MEDICAL SUPPORT SYSTEM (EMSS) FOR THE SUPPORT OF THE FLIGHT CREW (AREA 5.2)

CONCLUSIONS AND RECOMMENDATIONS

- A. MAINTAIN EMSS AS PREVIOUSLY USED THROUGH STS-9 (SPACE LABORATORY 1). CHANGE ONLY TO IMPROVE QUALITY OR EFFICIENCY OF CREW CARE.
- B. SEPARATE EMSS EFFORTS FOR CREW AND LAUNCH TEAM SUPPORT FROM THAT PROVIDED FOR THE INVITED VISITORS. EMPHASIS IN FUTURE SHOULD BE TOWARD CREW, LAUNCH AND LANDING EMSS SUPPORT, WITH REDUCTION IN VISITOR CARE SUPPORT.
- C. MOVE THIS EFFORT TOWARD AN IN-HOUSE (NASA-DOD) OPERATION FOR ALL FLIGHT RELATED EMSS EFFORTS THROUGH PICKUP, EMERGENCY CARE, TRIAGE AND TRANSPORT OF CASUALTIES FOR FURTHER CARE.

IMPACT UPON THE KSC BIOMEDICAL OFFICE

- A. PERMITS GAINING ADDITIONAL OPERATIONAL FLIGHT EXPERIENCE WITH A SECOND ORBITER, FURTHER EXPERIENCE WITH THE INCLUSION OF A NUMBER OF DOD PERSONNEL IN THE EMSS, AND THE EXPERIENCE GAINED FROM THE INITIAL LANDINGS AT KSC. THIS INFORMATION CAN BE OF GREAT VALUE BEFORE PUTTING THE FINAL OPERATIONAL EMSS INTO PLACE. ALSO PERMITS DISCUSSIONS AND RENEGOTIATED COMMITMENT OF LOCAL MEDICAL COMMUNITY TO BE COMPLETED BEFORE FINAL DECISIONS ARE MADE REGARDING THEIR ROLE IN FUTURE FLIGHT OPERATIONS.
- B. START PLANNING FOR REVISION OF CREW, LAUNCH AND LANDING SUPPORT TO BE PUT INTO PLACE AFTER THE STS-9 FLIGHT, BEFORE THE ACCELERATION OF THE FLIGHT SCHEDULE AND BEFORE THE INITIATION OF REGULAR LANDINGS AT KSC. EXPERIENCE ON LEVEL OF CARE SOUGHT AND NUMBERS NEEDING CARE FROM VISITORS SITES WOULD INDICATE THAT MEDICAL SUPPORT CAN BE REDUCED AND STILL REMAIN ADEQUATE. RESOURCES GAINED CAN BE REASSIGNED TO CREW, LAUNCH AND LANDING TEAM SUPPORT EMSS.
- C. AS FLIGHTS BECOME ROUTINE AND REGULAR (AVERAGE ONE/MONTH) THE AVAILABILITY OF LOCAL MEDICAL RESOURCES TO MAN THE EMSS SHOULD BE EXPECTED TO BE GREATLY REDUCED. TIME FOR THIS ACTIVITY WILL APPROACH 10-15 DAYS PER MONTH FOR ACTUAL MISSION AND MORE TO INCORPORATE TRAINING AND FIELD PRACTICE - THUS REQUIRE A DEDICATED GROUP ON A CONTINUING BASIS TO COVER THIS REQUIREMENT.

Chart 2. (continued)

EMERGENCY MEDICAL SUPPORT SYSTEM INTEGRATION WITH THE MEDICAL DISASTER
PLANNING FOR KSC AND CCAFS (AREA 5.3)

CONCLUSIONS AND RECOMMENDATIONS

A. COMPLETE AND INTEGRATE THE KSC MEDICAL ASPECTS INTO THE KSC DISASTER PLAN (MANUAL). SINCE COMMON MEDICAL RESOURCES ARE USED BY KSC AND CCAFS, INTEGRATE THE MEDICAL ASPECTS INTO A COMBINED KSC/CCAFS MEDICAL RESPONSE TO DISASTERS.

B. PERIODICALLY EXERCISE THE OVERALL MEDICAL PLAN, USING IN-HOUSE (NASA AND DOD) RESOURCES AND INTERFACE WITH LOCAL MEDICAL COMMUNITY TO ENSURE THE MEDICAL ASPECTS OF EMERGENCY CARE AND TRANSPORT THAT INTERFACE WITH THE LOCAL MEDICAL FACILITIES ARE READY. SIMILAR EXERCISES SHOULD BE CONDUCTED TO TEST, TRAIN, AND TO ACTIVATE THE ENTIRE DISASTER PLAN, INCLUDING ALL ELEMENTS ON THE CENTERS (SECURITY, FIRE, COMMAND AND CONTROL, COMMUNICATIONS, MEDICAL, ETC.) AND THE ELEMENTS OF THE LOCAL CIVIL DEFENSE SYSTEM.

IMPACT UPON THE KSC BIOMEDICAL OFFICE

A. THE INTEGRATION OF THE MEDICAL ASPECTS OF THE PLANS OF KSC/CCAFS WILL ENSURE A COORDINATED RESPONSE IN THE EVENT THAT A DISASTER INVOLVING BOTH CENTERS WAS TO OCCUR. SINCE DISASTERS CAN BE DUE TO AN ACCIDENT OR EMERGENCY IN FLIGHT THAT COULD AFFECT ONE CENTER OR BE A NATURALLY OCCURRING EVENT AND REQUIRE A RESPONSE AT BOTH CENTERS, PLANNING FOR THE MEDICAL ASPECTS OF THE PLAN MUST REFLECT SUCH A FULLY COORDINATED EFFORT. WITH AN INTEGRATED PLAN, A PARTIAL TEST OF THE MEDICAL PORTIONS OF THE OVERALL PLAN CAN BE MADE A REGULAR PART OF THE PRELAUNCH AND PRELANDING TRAINING EXERCISES.

B. PERIODICALLY EXERCISING THE ELEMENTS AND ENTIRE SYSTEM HAS PROVEN TO BE THE ONLY RELIABLE WAY OF ASSURING A DISASTER PLAN IS READY WHEN IT IS NEEDED. EXPERIENCE AT OTHER PLACES HAVE SHOWN THAT PERSONNEL NEED PERIODIC TRAINING TO ENSURE THAT THEY CAN RESPOND APPROPRIATELY TO AN ACTUAL EMERGENCY OR DISASTER.

Chart 2. (continued)

AEROSPACE MEDICINE PROGRAM (AREA 5.4.1)

CONCLUSIONS AND RECOMMENDATIONS

- A. DEVELOP A SHORT-RANGED AND A LONG-RANGED PLAN FOR PROVIDING THE AEROSPACE MEDICINE PROGRAM AT KSC. PLAN NEEDS TO DEFINE LEVELS AND TYPE OF CARE AND WHO WILL PROVIDE CARE. PLAN SHOULD ADDRESS BOTH NASA AND DOD NEEDS FOR THIS SERVICE. IF KSC IS TO BE REQUESTED TO ASSUME THE CONDUCT OF THE CARE, THE PLAN NEEDS TO REFLECT THE SCHEDULE FOR ASSUMPTION OF THE EFFORT. IN THE LONG-RANGED PLAN THE QUESTION SHOULD BE ADDRESSED WHETHER THE CREW WILL CONTINUE TO BE AT KSC ON TRAVEL OR EVENTUALLY MOVE TO KSC FOR OPERATIONS?

IMPACT UPON THE KSC BIOMEDICAL OFFICE

- A. AS THE FLIGHTS BECOME MORE ROUTINE, FREQUENT, HAVE INCREASED NUMBERS OF CREW MEMBERS AND INCREASED NUMBERS OF PAYLOADS, THE NUMBER OF CREW MEMBERS AT KSC AT ANY ONE TIME AND THE AMOUNT OF TIME SPENT AT KSC IN PREPARATION FOR A FLIGHT (ESPECIALLY MISSION AND PAYLOAD CREW MEMBERS) SHOULD INCREASE AND THEREBY INCREASE DEMAND FOR CARE. IF THIS SHIFT OF TIME AT KSC IS SUFFICIENT, THE OPTION TO HOUSE CREW MEMBERS AT KSC COULD BECOME MORE ATTRACTIVE. THE AEROSPACE MEDICINE PROGRAM AND THE FACILITY IN WHICH TO CONDUCT IT NEEDS TO BE DESIGNED AND SCHEDULED TO MEET ESTABLISHED REQUIREMENTS.

Chart 2. (continued)

OCCUPATIONAL MEDICINE AND ENVIRONMENTAL HEALTH PROGRAM (AREA 5.4.2)

CONCLUSIONS AND RECOMMENDATIONS

A. CONTINUE THE MANAGEMENT OF THE CURRENT PROGRAM UNDER THE BIOMEDICAL OFFICE. MAINTAIN ALL PRESENT ELEMENTS OF THE OMEHS PROGRAM PER NASA NMI.1800.1C WITHIN THIS CENTRAL SINGLE MANAGEMENT.

B. PREPARE OMEHS STAFF, CENTER MANAGEMENT AND THE CONTRACTOR PERSONNEL FOR THE POTENTIAL IMPACT THAT THE INTENSE, PROLONGED HIGH LEVELS OF WORK AND WORKER STRESS THAT CAN RESULT FROM THE STS MISSION SCHEDULE. PREPARE OMEHS AND WORK PLACE SUPERVISORS TO BE ALERT TO EMPLOYEES WHO ARE BEGINNING TO SHOW SIGNS OF STRESS IN ORDER THAT CARE AND ACTIONS CAN BE TAKEN BEFORE THE EMPLOYEE'S STRESS BECOMES A PROBLEM ON THE JOB.

IMPACT UPON THE KSC BIOMEDICAL OFFICE

A. OTHER APPROACHES TO MANAGEMENT OF OMEHS PROGRAM PROVIDE NO ADVANTAGES AND DO CAUSE PROBLEMS OF MANAGEMENT OVERSIGHT, PROGRAM CONTROL AND QUALITY CONTROL. OTHER APPROACHES CAUSE FRAGMENTATION OF THE EFFORT; COULD PRODUCE DIFFERENT STANDARDS FOR EXPOSURE, DIAGNOSIS, CARE, ASSESSMENT OF DISABILITY. SOLUTIONS TO ENVIRONMENTAL HEALTH AND HYGIENE ISSUES OFTEN REQUIRE MULTI-DISCIPLINE APPROACHES. CENTRALIZED MANAGEMENT SIMPLIFIES THE SOLUTION TO THESE ISSUES AND PLACES RESPONSIBILITY AND CONTROL IN THE SIMPLEST AND MOST DIRECT MANAGEMENT STRUCTURE.

B. A PROLONGED CONTINUATION OF THE INTENSE WORK DEMANDS, THAT CAN BE EXPECTED TO BE NEEDED TO MEET THE STS SCHEDULE, CAN LEAD TO INCREASED ILLNESS, ERRORS IN THE WORK PLACE, ABSENTEEISM, FAMILY DISTURBANCES, AND EMPLOYEE TURN OVER. THE OMEHS STAFF AND THE FIRST LINE SUPERVISORS OFFER THE BEST PLACE TO DETECT THESE EARLY SIGNS OF STRESS. BOTH AREAS SHOULD BE BRIEFED AND ALERT TO IDENTIFYING THESE SIGNS EARLY IN ORDER THAT THE INDIVIDUAL PROBLEM IS CAUGHT AND BROUGHT UNDER CONTROL BEFORE IT BEGINS TO THREATEN THE WORKER OR THE JOB BEING DONE.

Chart 2. (continued)

MEDICAL CARE FOR INVITED VISITORS FOR SHUTTLE OPERATIONS (AREA 5.5)

CONCLUSIONS AND RECOMMENDATIONS

- A. INITIATE PLANS TO LIMIT VISITOR ATTENDANCE AND MAINTAIN CLEAR ROADWAYS DURING LAUNCH AND LANDING. THIS WILL FREE UP USE OF GROUND TRANSPORTATION FOR MOST MEDICAL MOVEMENT OF THE ILL AND INJURED.
- B. REDUCE MEDICAL SUPPORT AT EACH VISITORS SITE TO LEVEL OF "FIRST AID" ONLY AND WITH A "CALL UP" OF AN AMBULANCE IF NEEDED. AMBULANCE, HELICOPTERS AND MEDICAL TEAMS AT OMEHS AND BOSU ON ALERT AND READY FOR DISPATCH ONLY WHEN REQUIRED. IF ONE MEDICAL UNIT IS DISPATCHED, MOVE UP THE NEXT TEAM IN READY STATUS. THIS SHOULD MINIMIZE THE ACTUAL USE OF EQUIPMENT AND PERSONNEL FOR EACH FLIGHT.

IMPACT UPON THE KSC BIOMEDICAL OFFICE

- A. EXPERIENCE WITH VISITORS HAS SHOWN AN INFREQUENT REQUIREMENT FOR CARE. DIAGNOSES AND LEVEL OF CARE PROVIDED TO DATE HAVE BEEN PRIMARILY AT FIRST AID LEVEL. PRESENT LEVELS OF TRAFFIC ON ROADS LIMITS USE OF GROUND TRANSPORTATION FOR MOVING PATIENTS IN AN EMERGENCY. THEREFORE, USE OF HELICOPTERS IS EXPECTED MORE THAN DIAGNOSIS WOULD REQUIRE. HELICOPTERS ON STANDBY WILL STILL BE NEEDED BUT ONLY FOR A TRUE EMERGENCY THAT REQUIRES THIS ACTION, BUT NOT FOR ROUTINE CARE.
- B. REDUCTION IN THE NUMBER OF MEDICAL PERSONNEL AT EACH VISITORS SITE WILL FREE UP THE NASA AND OMEHS CONTRACTOR PERSONNEL FOR ASSIGNMENT TO CREW, LAUNCH AND LANDING TEAM SUPPORT EMSS, THAT WILL BE REQUIRED TO MEET THE FLIGHT SCHEDULE AND TO REFLECT A SHIFT TO IN-HOUSE NASA/DOD STAFFING.

Chart 2. (continued)

NON-HUMAN EXPERIMENT SUPPORT (AREA 5.6.1)

CONCLUSIONS AND RECOMMENDATIONS

- A. LSSF (HANGAR L) DESIGN AND PROVISIONS ARE ADEQUATE TO MEET CURRENT NEEDS. POTENTIAL FOR FUTURE GROWTH SHOULD BE ABLE TO MEET NEW AND UNFORSEEN REQUIREMENTS.
- B. PLANNING FOR EFFICIENT USE OF THE FACILITY SHOULD BE STARTED NOW TO ENSURE READINESS TO ACCOMMODATE ALL USERS.
- C. OBTAIN CERTIFICATION OF THE ANIMAL FACILITY FOR HOUSING ANIMAL CARE.

IMPACT UPON THE KSC BIOMEDICAL OFFICE

- A. JOINT ARC/KSC REQUIREMENTS DOCUMENT DID EXCELLENT JOB IN ANTICIPATING THE FUTURE NEEDS. DESIGN SHOWED EXCELLENT ARC/KSC INTERACTION AND PLANNING. SHOULD BE ABLE TO MEET THE FUTURE REQUESTS OF THE CENTERS AND INVESTIGATORS EVEN THOUGH SPECIFICS HAVE NOT BEEN IDENTIFIED.
- B. GOOD EARLY PLANNING SHOULD PERMIT THE AVOIDANCE OF A LACK OF READINESS OR INADEQUACY OF SUPPORT OF USERS AS THEY ARRIVE AND USE THE FACILITY. THIS BECOMES A VITAL ASPECT OF THE OPERATIONS OF THE LSSF AS MID-DECK AND CARRY-ON EXPERIMENTS ARE IDENTIFIED.
- C. A QUALIFIED AND CERTIFIED SET OF POLICIES, PROCEDURES AND FACILITY WILL ASSURE ACCEPTABLE CARE AND USE OF ANIMALS AND MINIMIZE PROBLEMS WITH ANIMAL PROTECTION GROUPS.

HUMAN EXPERIMENTS SUPPORT (AREA 5.6.2)

CONCLUSIONS AND RECOMMENDATIONS

- A. DEVELOP A DEFINITIVE REQUIREMENTS DOCUMENT FOR HUMAN EXPERIMENTS SUPPORT FOR NASA AND DOD.
- B. DEFINE, DESIGN AND DEVELOP THE FACILITIES NEEDED TO PROVIDE SUPPORT FOR THESE EXPERIMENTS USING HUMAN TEST SUBJECTS. FACILITIES DESIGN SHOULD BE GENERAL, FLEXIBLE AND ASSIGNABLE TO DIFFERENT DISCIPLINES AS EXPERIMENTS ARISING FROM ALL SOURCES ARE IDENTIFIED.

IMPACT UPON THE KSC BIOMEDICAL OFFICE

- A. A KEY OBJECTIVE FOR GAINING A LONGER-RANGED PLAN FOR KSC AS A SPACEPORT.
- B. KSC PLANNING MUST ANTICIPATE THAT PAYLOADS, ESPECIALLY THE CARRY-ON AND MID-DECK EXPERIMENTS, WILL GROW IN NUMBERS AND FREQUENCY IN FLIGHT. THE EXPERIENCE IN PLANNING FOR THE NON-HUMAN EXPERIMENT SUPPORT FACILITY CAN BE USED AS A MODEL FOR DEVELOPING A GENERAL, FLEXIBLE FACILITY FOR SPACEPORT (EAST).

Chart 2. (continued)

INTERFACE BETWEEN THE CREW AND LIFE SCIENCES NON-HUMAN FLIGHT EXPERIMENTS
(AREA 5.6.3)

CONCLUSIONS AND RECOMMENDATIONS

- A. NASA SHOULD DEVELOP AN AGENCY SET OF GUIDELINES FOR USE IN EXPOSING THE FLIGHT CREW TO THE BIOLOGICAL PAYLOAD, OR VICE VERSA TO AVOID PROBLEMS FOR THE MISSION OR EXPERIMENTAL RESULTS.
- B. "SOLICIT OUTSIDE EXPERTISE IN THE DEVELOPMENT OF GUIDELINES FOR NASA AS A WAY OF ENSURING THE BEST KNOWLEDGE IN THE SCIENTIFIC FIELDS IS INCORPORATED INTO THE EFFORT. SUCH OUTSIDE ASSISTANCE WOULD AVOID THE SCIENTIFIC AND POLITICAL KIBITZING THAT WOULD ARISE AFTER A PROBLEM OCCURRED AND IT WAS SHOWN THAT NASA HAD NOT USED THE EXISTING EXPERTISE IN THE AREA IN FORMING ITS GUIDELINES AND MANAGEMENT POLICIES."

IMPACT UPON THE KSC BIOMEDICAL OFFICE

- A. THIS REPRESENTS THE FIRST MAJOR NASA EFFORT TO FLY BIOLOGICAL EXPERIMENTS ON MISSIONS THAT WILL INVOLVE CREW MEMBERS IN THE EXPERIMENTAL PROCESS. THERE ARE ISSUES CONCERNING THE EFFECTS UPON THE CREW, UPON THE EXPERIMENT AND UPON THE MISSION THAT NEED DEFINITION AND PLANNING TO ENSURE THAT SUCH EXPOSURE DOES NOT NEEDLESSLY ELIMINATE EXPERIMENTS OR INFLUENCE THE RESULTS. IN THE SAME VEIN, PLANNING SHOULD PROVIDE GUIDELINES THAT WILL AVOID ILLNESS, SENSITIVITY AND REACTION OF THE CREW TO THE EXPERIMENTAL MATERIAL. THIS IS AN IMPORTANT ELEMENT IN THE PREPARATION OF KSC AS A SPACEPORT.
- B. OUTSIDE EXPERTISE AND ADVICE DESIRED BECAUSE OF THE LIMITED EXPERIENCE IN NASA ON THE PROBLEM OF TRANSFER OF EFFECTS BY ANIMALS TO MAN AND VICE VERSA. BY GOOD PLANNING UP FRONT PROBLEMS OF ILLNESS IN CREWS OR LOSS OF DATA FROM EXPERIMENTAL ANIMALS CAN BE MINIMIZED.

Chart 3. SUMMARY CONCLUSIONS AND RECOMMENDATIONS FROM SECTION 6, LIFE
SCIENCES RESEARCH AT THE KSC

CONCLUSIONS AND RECOMMENDATIONS

A. KSC BIOMEDICAL OFFICE, IN CONCERT WITH THE KSC CENTER MANAGEMENT, DEVELOP A LONG-RANGED LIFE SCIENCES AND BIOTECHNOLOGY RESEARCH AND DEVELOPMENT PLAN THAT WILL LEAD TO KSC BECOMING A FULL LIFE SCIENCES RESEARCH CENTER FOR NASA. THIS PLAN SHOULD FULLY RECOGNIZE THE EXISTING AND FUTURE DEVELOPMENT OF THE FLIGHT EXPERIMENT SUPPORT AT KSC, AND THE FACILITIES THAT ARE REQUIRED TO SUPPORT THE FLIGHT EXPERIMENT. THE RESEARCH AND DEVELOPMENT PLAN SHOULD BE DIRECTED TOWARD THE FULL UTILIZATION OF THESE EXCELLENT FACILITIES AS KSC-SPACEPORT (EAST) MATURES.

IMPACT UPON THE KSC BIOMEDICAL OFFICE

A. WITH THE FACILITIES PUT INTO PLACE IN THE INTRAMURAL RESEARCH PROGRAM AND FOR THE SUPPORT OF THE STS FLIGHT OPERATIONS, NASA WILL HAVE CREATED ONLY THE SECOND CENTER IN NASA THAT IS ABLE TO CONDUCT A FULL SPECTRUM OF LIFE SCIENCES EXPERIMENTATION. THESE FACILITIES ARE NEEDED TO MEET THE PROJECTED STS FLIGHT EXPERIMENT PROGRAM AND WILL CONTINUE TO BE NEEDED WHEN THE SPACE STATION PROGRAM IS IN PLACE. IN SPITE OF A BUSY PROGRAM OF SUPPORT FOR THE STS THERE SHOULD BE AMPLE SPACE, TIME, STAFF, RESEARCH IDEAS THAT CAN BE CONDUCTED IN THE INTERIM BETWEEN FLIGHTS. PROGRAM AND FUNDING APPROVAL WILL BE NEEDED. WITH THE COMBINATION OF DEDICATED LIFE SCIENCES MISSIONS, THE EVOLVING CARRY-ON AND MID-DECK EXPERIMENTS PROGRAM AND THE STUDENT SCIENCE PROGRAM, THESE FACILITIES MUST BE MAINTAINED READY FOR FLIGHT SUPPORT. THIS WILL PERMIT THE ADDITIONAL WORK TO BE PERFORMED IN THE INTRAMURAL PROGRAM AT A LESSER COST/UNIT OF RESEARCH. ADDING SUCH RESEARCH AT KSC WILL ALSO ENHANCE ITS ABILITY TO ADDRESS INTRINSIC ISSUES AT KSC.

Chart 3. (continued)

CONCLUSIONS AND RECOMMENDATIONS

- B. TO MEET THE LONG-RANGED RESEARCH GOALS, DIALOGUE SHOULD BE INITIATED TO ESTABLISH LIFE SCIENCES RESEARCH PROGRAMS AND THE ASSOCIATED FUNDING FROM MULTIPLE SOURCES WITHIN NASA, WITHIN OTHER FEDERAL AGENCIES AND OTHER ORGANIZATIONS AND UNIVERSITIES THAT CAN EXPLOIT THE UNIQUE CHARACTER OF THE KSC ENVIRONMENT GEOGRAPHY AND FLORA AND FAUNA.
- C. RECOGNIZE AND ADDRESS THE SENSITIVITY OF THE OTHER NASA CENTERS TO THIS PROPOSED INCREASE IN R&D AT KSC AND ENSURE THAT THEIR FLIGHT OPERATIONS NEEDS ARE FULLY MET IN PREPARATION OF EXPERIMENTS FOR FLIGHT.

IMPACT UPON THE KSC BIOMEDICAL OFFICE

- B. A LONG-RANGED CENTER MARKETING EFFORT IS RECOMMENDED AS A WAY OF SEEKING OUT RESEARCH SUPPORT FROM SEVERAL OFFICES WITHIN NASA INCLUDING: THE DIRECTOR OF LIFE SCIENCES, OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY, SPACE STATION TASK FORCE AND THE STS PROGRAM. OTHER SOURCES OUTSIDE NASA CAN BE SOLICITED AS WELL, INCLUDING THE DOD, NSF, NAS AND DEPARTMENTS OF HHS, AGRICULTURE, ETC., ENABLING RESEARCH SCIENTISTS FROM UNIVERSITIES AND ORGANIZATIONS TO USE THE UNIQUE ENVIRONMENT, ECOLOGY AND THE GEOGRAPHIC AREA AT KSC. NEGOTIATION SHOULD MOVE TOWARD OBTAINING A LEVEL OF FUNDING FOR THE EFFORT THAT WOULD BE MAINTAINED AS LONG AS THE PRODUCT OF THE EFFORT IS JUDGED SATISFACTORY BY THE SPONSOR.
- C. MEET THE REQUESTS OF THE CENTERS AND INVESTIGATORS AS NEGOTIATED. ESTABLISH WITHIN NASA THAT KSC LIFE SCIENCES INTRAMURAL RESEARCH IS A FULL PARTNER IN THE NASA LIFE SCIENCES RESEARCH PROGRAM THROUGH THE ESTABLISHMENT OF A KSC RTOP SIMILAR TO THAT PROVIDED FOR OTHER NASA CENTERS. KSC WILL NEED TO START FULL PARTICIPATION IN RESEARCH, PROGRAM PLANNING AND REVIEWS AS A FULL PARTNER.

Chart 4. SUMMARY AND CONCLUSIONS AND RECOMMENDATIONS FROM SECTION 7, KSC LIFE SCIENCES FACILITIES REQUIREMENTS FOR SPACEPORT (EAST)

CONCLUSIONS AND RECOMMENDATIONS

- A. DEVELOP AN OVERALL LONG-RANGED PLAN FOR THE TOTAL KSC LIFE SCIENCES ACTIVITIES. THE PLAN SHOULD INCLUDE THE CREW MEDICAL CARE AND SUPPORT FOR FLIGHT OPERATIONS, THE SUPPORT FOR ALL FUTURE LIFE SCIENCES FLIGHT EXPERIMENTS WHILE AT KSC, THE INTRAMURAL LIFE SCIENCES RESEARCH PROGRAM AT KSC.
- B. ESTABLISH A PROGRAM TO COMPLETE THE DESIGN AND PLACEMENT OF THE FACILITIES AND STAFFING NEEDED TO ACCOMPLISH THE GOALS AND OBJECTIVES IDENTIFIED IN THE LONG-RANGED PLAN. FOR THIS EFFORT IT IS RECOMMENDED THAT SOME EXISTING FACILITIES BE ACCEPTED AS INTERIM. ONCE ACTUAL NEEDS ARE DEFINED AND TRANSLATED INTO REQUIREMENTS INTERIM PROVISIONS MAY PROVE INADEQUATE AND NEED TO BE REPLACED. IN PLANNING FOR ANY NEW FACILITIES IT IS RECOMMENDED THAT COLLOCATION AND CROSS UTILIZATION OF FACILITIES BE ESTABLISHED AS PRINCIPLES OF USE. THIS SHOULD PERMIT THE BEST ECONOMIES OF USE AND STAFFING. COLLOCATION OF THE MEDICAL OPERATIONS SUPPORT, HUMAN EXPERIMENTS SUPPORT AND INTRAMURAL HUMAN RESEARCH PROGRAM ALSO SHOULD BE CONSIDERED WITH PLACEMENT OF THE CREW QUARTERS AND/OR OFFICES.

IMPACT UPON THE KSC BIOMEDICAL OFFICE

- A. PLANNING FOR RESEARCH FACILITIES HAVE IN THE PAST BEEN INCREMENTAL, FRAGMENTARY AND ONLY AS NEEDED. THIS HAS RESULTED IN LESS THAN EFFICIENT AND LIMITED CAPABILITIES IN PRESENT FACILITIES AND LIFE SCIENCES AREAS EXCEPT THE NON-HUMAN EXPERIMENT SUPPORT FACILITY (i.e., LSSF, HANGAR L). WITH KSC NOW TARGETED TO BECOME A FULL FLEDGED SPACEPORT, AND LIFE SCIENCES AT KSC BEING AN IMPORTANT PART OF THAT MISSION. PLANNING NEEDS TO RECOGNIZE THAT FOR THE LONG TERM A SET OF FLEXIBLE, INTEGRATED AND COLLOCATED FACILITIES NEED TO BE BUILT AT KSC TO EFFICIENTLY DO THIS JOB.
- B. THE FIRST CUT AT THE RESOURCE NEED IS INCLUDED IN SECTION 7 BOTH AS RAW DATA AND AS SUMMARIZED TO SHOW INITIAL GAINS TO BE GOTTEN THROUGH COLLOCATION AND CROSS UTILIZATION. THIS EFFORT SHOULD SERVE AS A BASIS FOR BUILDING THE BIOMEDICAL OFFICE FACILITY REQUIREMENTS INTO A VIABLE ENGINEERING DESIGN. INTERIM ADDITIONS MAY BE REQUIRED UNTIL THE FINAL OVERALL DESIGN IS IMPLEMENTED.

Introduction

The transfer of the STS program from DDT&E to operational status was announced following the successful completion of the fourth STS flight. This represents an important milestone in the STS program and its completion offers an appropriate time for making the transition toward more routine mission operations. Of major significance to the STS program will be the shift in mission objectives from one of testing the flight vehicle to one of carrying payloads to orbit, launching them and/or conducting research and the testing of them while in orbit. The payload will become the primary variable and a research, development, test and evaluation (RDT&E) component of the mission. Traditionally the decision to transition an aerospace system from DDT&E or RDT&E to operational status has been made based upon the accumulated data showing satisfactory performance, maturity, reliability and confidence in the system. The STS in this case, is following this tradition.

The transfer of the STS program to operational status also opens a new era for the KSC. Prior to this KSC had participated in a supporting role for each DDT&E or RDT&E program during their flight period at KSC. As a result the mission role of KSC had been limited to one of providing what was requested by the lead NASA center for each program. Major aspects of planning and the conduct of the flights were retained by the lead center.

The transfer of the STS program to operational status represents a new endeavor for NASA as well because it represents the first major operational program to be assumed by the agency. If the STS transition follows the usual trend for an aerospace system it should result in the flight operations becoming more routine and repetitive in nature with the payload being the new element for each flight. The flight operations at KSC therefore, should approach that of a busy international airport, in this case a spaceport. The projected flight manifest will demand a highly efficient, dynamic, and flexible operation at KSC as the STS vehicles and payloads are processed and prepared for flight and the postlanding processing is completed. Most of the work associated with the flight operations will be conducted at KSC. Therefore, the burden of meeting the schedule will fall upon the work force at KSC even though the overall mission planning can still be handled by another lead NASA center.

Since this represents the first such effort for the United States space program the detailed build-up of the operational phase of the program warrants careful attention. It would appear reasonable and timely to reexamine past policies and practices to see if they will best serve this new era. The reexamination should also consider whether the present facilities at KSC are adequate to provide the capability that will be required at a spaceport over the next decades. There is extensive experience upon which the examination can draw. These include: the NASA flight experience gained from earlier programs and the DDT&E flights of the STS; the experience of

other federal agencies as they have shifted their programs through the various phases of maturation; the experience of other non-government companies as they have been required to make a similar transition of a research effort to production and into the operational marketplace.

A part of the reexamination should be the reassessment of the current biomedical policies, the life sciences programs for the support of the STS flights and the NASA life sciences research programs to see whether they are tuned to the needs of the future STS operations. This reassessment should result in the reconfirmation, redefinition, and revision of current policies and provisions for those portions of the biomedical program that have been tested and to identify new requirements that can now be envisioned due to the change in the STS operational and KSC mission status.

As an example, a look at the Emergency Medical Support System (EMSS) for an STS mission could be expected to result in a shift toward a more routine support system. Generally such a trend would be expected to permit a reduction of the requirements for clinical medical support because there will be an ever increasing degree of understanding of what and where problems might occur and result in the correction of those problems that require it and compensation for those that do not. There should be understanding of what the risks for the crew will be that might require medical attention. Taken on its own merit, a successful operational flight program would be expected to simplify, and perhaps ease, the concerns and the need for medical support.

However, in the case of the future STS flight operations, there are some major offsetting events to the expected trend. These include: a) an increase in the frequency of flights beginning in mid to late 1983; b) an increase in crew size toward the maximum capacity of seven per flight, a trend that began with STS-5; c) the addition of new shuttle flight vehicles to the program which may require special attention during their initial shakedown flights; d) an increase in payload complexity, the number of experiments/flight and the involvement of crew members in payload operation, including those of a life sciences or medical operational character; e) the initiation of routine landing at KSC at the end of mission beginning in early to mid 1983; f) an extension of mission duration as the desire for more data, and an increasing return on the mission costs to be obtained per mission is sought. Each of these could require increased frequency of use and an increased level of biomedical support required.

Just as important, since the RDT&E aspects of the mission will be centered upon the payload, one could expect the increased involvement of the Mission and Payload Specialists in the payload development, integration and checkout, all activities that will be performed at KSC. As a result these crew members can be expected to spend more time at KSC during payload preparation than occurred on earlier STS missions. This would place upon the KSC Biomedical Office and the contractor for Occupational Medicine and Environmental Health System (OMEHS) an increasing requirement for their day to day medical care. The degree of involvement and the

course to be followed by the Mission and Payload Specialists in payload preparation has still not been defined. However, medical planning would be wise to anticipate that they will be more involved and therefore spending increasing periods of time at KSC.

To date the NASA approach to planning flight medical operations has assumed that all of the flight crew members have been selected from a homogeneous population. Therefore, the data that have been collected during all previous flight missions are assumed to be directly applicable in making any projections as to what will happen as far as crew adaptation to the space environment is concerned. It is also assumed that this data base should provide solid insight into the magnitude, the sequence, and the significance of these adjustments for the mission lengths expected for the STS program. As a result NASA is expressing a high degree of confidence in the ability of the crewmen to successfully adjust to mission durations proposed for shuttle and further that the crew members will be able to perform the work on the time-lines proposed for the tasks.

However, it should be noted that the initiation of flight by Mission and Payload Specialists does offer the potential for another dimension of medical interest, the inclusion of people in the crew that come from different backgrounds and experience than the traditional test pilot and pilot astronauts. Even though the NASA Mission and Payload Specialists have followed an intensive program to make their experience approach their predecessors, a question remains as to whether this change in crew origin and background will

be reflected in a difference in their ability to adapt and operate in space over that seen in previous flights. If it were to occur it would be reflected as a variation from the accumulated data base. This could lead to a question as to whether changes in training, conditioning, flight preparations and flight time-line planning will be needed to offset any differences that may be identified. If changes are seen, it could become a prime concern because the flights planned between 1982 and 1986 are primarily ones of one week or less in duration and will demand the early proficient performance of the specialists after they arrive in orbit.

The inclusion of this more diverse population in the crews aboard the STS also serves as the initial step in meeting an earlier NASA commitment to fly "all who need to make such a mission" as long as the flight of such individuals will not threaten the mission or the health or injury of the individual. In November, 1982, NASA reaffirmed this commitment by offering to consider the flight of a payload specialist proposed by the primary sponsor of a payload. Medical Operations will continue to have an important role in helping to decide who can and who should not fly medically.

The initiation of the return of the STS vehicle back to KSC after each mission will add to the medical support work load at KSC. The launch and recovery medical support effort will approach being a dedicated one when one considers the increased frequency of launches and all of the phases of the prelaunch, launch, preparation for landing, landing and postlanding activities. While one could easily

persuade the local medical community to provide support for an occasional launch, every three to six months, providing such a resource on a more or less permanent and dedicated basis may make the current approach less than acceptable to this community. The issue of planning for a dedicated medical operations support team needs early attention since it may require the further development of the permanent members of the team from within KSC to meet the scheduled flight operations. Other sources of help, such as DOD or other outside medical resources, could be planned for augmenting the routine operations on an "as needed" basis in the event an accident occurred which resulted in injury to the crew or to the supporting personnel during a launch and landing.

The ground support work required to meet the projected increased frequency of flight is proposed to be accomplished with the same basic size of NASA and contractor work force that presently exists. This was a KSC goal stated in the request for proposal for the Base Operations Contract (BOC). If this continues as a KSC goal, it will require markedly increased productivity, efficiency, and probably an increase in the use of overtime to meet the projected schedule for the launch and landing events now scheduled through 1986. This prolonged projection of high work level may result in an increase in work related stress of the employees. The scientific literature reports that in industry where such an intense work schedule is maintained for a prolonged period, it results in an increase in medical problems in the work force, absenteeism, and personnel turnover. All of these occurrences could increase the potential for

further enlarging the work load for the Biomedical Office and the Occupational Medical and Environmental Health contractor.

The discussion above testifies to the dynamic nature and the state of flux of plans for the future shuttle flight operations. It clearly recommends the need for and timeliness of a review of the medical operations support of the STS program, the occupational medical and environmental health program, the human and non-human experiment support efforts, and research programs that are managed by the Biomedical Office. This report provides this review, identifies issues needing timely decisions and where appropriate provides alternative solutions to the issues.

2.0

Scope Of Study

This study provides an analysis of the medical operations, the life sciences flight experiments support requirements, and the intramural research program expected to be at KSC during the operational flight period of the STS; compares the adequacy of available facilities, plans, and resources against these future needs; and proposes revisions and/or alternatives where appropriate.

Background

The successful completion of the STS-4 was followed by the declaration that the space shuttle is now operational. Accomplishing this major milestone signals a change in the STS program from testing and demonstrating the orbiting vehicle to one of providing transportation of payloads to space.

During the RDT&E phase of a new aerospace system major medical provisions are made to ensure readiness to meet any contingency, ranging from a normal mission to one of total failure. The medical planning at KSC for the early space shuttle flights was most important because all of the DDT&E flights would test a totally new astronautical-aeronautical concept and each flight would be manned. The medical planning for the STS DDT&E flights were designed to meet the worst case scenario, a major failure at launch which could result in injury of the crew, the launch support staff and/or visitors viewing the launch.

The success of the DDT&E flights and experience gained will permit an intelligent reassessment of the medical support system for future STS flights. The transition of the STS program to the operational mode should be expected to trigger a number of changes in the medical support requirements and provisions at KSC. It should be expected that these changes will occur over a period of time and, therefore, should be viewed as evolutionary and dynamic. As further experience is gained, additional changes should be anticipated.

This expected course of change will parallel similar adjustments of the medical support efforts that have occurred during earlier United States manned spaceflight programs. As experience was accumulated the future course to be followed became clear and the medical operational plan was adjusted. This point in time, the beginning of the transition of the STS vehicle to operational status, appears to be an appropriate time to start the reexamination of the present medical plans and the committed resources, and to refine, reconfirm, or revise the present medical support efforts to reflect this new era.

Space Shuttle and Expendable Launch Vehicle (ELV) Schedules Impact
Upon KSC Medical Support

An intelligent assessment of the future biomedical plans for the support of flight operations, the life sciences experiments and the intramural research at KSC requires an understanding of what the flight and mission plans and schedules for the STS program will be, especially those aspects of the STS program that can impact the biomedical support provisions and place priority requirements upon their use. Since biomedical requirements for the STS missions draws upon a single set of medical resources at KSC it seems appropriate to also examine the other flight operations that may compete for these resources, namely the ELV program.

The discussion that follows used the mid-1982 edition of the flight manifest (JSC-13000-7, JSC-13000-8) as a reference document and the ELV schedule then current as the expected flight schedule for which medical and life sciences experiment support would be expected. Although the flight schedules should be expected to change, it was felt that the adjustment would not change the magnitude of medical needs, only the timing. From these flight schedules a model has been constructed that emphasizes the elements of the flight agenda that could influence the requirements and scheduling of the medical and life sciences experiment support. The model addresses the effects of: launch frequency; landing at KSC; mission durations; crew size and makeup; aerospace medical support of the flight crew at KSC; medical care for the visitors to a launch or landing event;

DOD participation in the medical support activities; medical support of expendable launch vehicle flights; KSC as Spaceport (East). Using this medical operational model, later discussions of specific aspects of the elements of the medical and experiment support programs will follow in this report.

4.1 Launch Frequency

The flight manifest of the STS indicates that the launches will continue at a frequency of roughly one per quarter through calendar 1983. This frequency of launch will coincide with the period during which the medical support program will be in transition between DDT&E phase and routine operations. However, after calendar 1983, the frequency of flights markedly increases to an average of one per month, the shortest interval being 0.5 month and the longest period being 1.5 months. This increased launch frequency is scheduled to continue into the late 1980s. The tempo at KSC will be maintained even though additional launches are projected to begin at Vandenberg Air Force Base (VAFB) in late 1985. Calendar 1983 permits the KSC work force, including the medical staff, to transition from DDT&E to routine operation and 1984-1985 to adjust to the overall increased work load at KSC before additional flights at VAFB are added. This launch frequency at KSC will require an almost continuous commitment of the medical team supporting flight preparation, launch and landing activities.

Landing At KSC

Present flight schedules plan for the STS to begin returning to KSC at the end of the STS-7 mission. This will add an additional flight related event to the routine operations at KSC from a medical point of view and will place an increased demand upon local medical resources. Even though other flights may land elsewhere, once the landings start at KSC, planning and preparation for these landings will become a part of the routine operation and must be incorporated into the KSC schedule. Commitment of medical resources are expected to begin one to two weeks before a mission, continue through the mission period (including the preparation for the landing) and end after the landing and the immediate postflight crew evaluation. The result is that approximately one month in three in 1983 and continuously after 1983 will be spent by the medical support team in the various phases of a mission. Recognizing that some flights are scheduled to be separated by less than one month, the medical teams will be required to hold multiple assignments to be able to cover the flights in preparation and underway. This demand upon the medical resources available at KSC will present a serious problem for the Biomedical Office and its occupational medical support contractor unless the amount of support per mission can be reduced while still maintaining an adequate level of support of flight operations and a responsive EMSS.

Mission Duration

The mission duration of flights throughout the 1980s will average five to seven days. Mission lengths vary from a few presently scheduled for three days and one of nine days length set for Space Laboratory 1. Prudent medical planning should expect mission duration to grow as further experience is gained and confidence in the vehicle and its systems grow. This has already occurred on the STS-9 (Space Laboratory 1) mission which has been extended from seven to nine days. Expendables on the STS vehicle can meet mission lengths up to ten days without major changes or penalty.

One might also anticipate that if the national decision to build a space station is not made in the next two or three years that further extension of the STS capability will be sought. A prolonged delay in the commitment to build a space station would tend to indefinitely extend the life of the STS vehicle as the primary operational flight base. Such a change would extend the current flight manifest into the 1990s. For planning purposes it is recommended that the frequency of flights scheduled for 1984 will continue regardless of whether the STS continues in its present role or shifts over to becoming a transport vehicle to be used in support of a space station. Planning should also anticipate that the mission lengths will be increased. A prolonged delay in the national decision to build a space station could cause a renewal of the early STS thinking which proposed the eventual extension of the shuttle orbit capabilities to support thirty day missions. Such

mission lengths would be gained through the additions of modules carrying expendable supplies. These would be added at the expense of payload capabilities. An increase in the number of shuttle vehicles could permit mission extensions and still meet the frequency of launches. Medical planning should anticipate this possibility because it could have a major impact upon the demands for KSC biomedical support.

Longer missions would also bring a renewed interest in the flight of more and longer length experiments. Life sciences is one of the prime NASA scientific areas that would be interested in longer flights. An announcement of opportunities for longer duration missions should trigger a broad response and result in a new family of longer duration experiments. The life scientist can be expected to view the extension of mission duration to two weeks from the current five to seven days as a magnitude of improvement in the experimental opportunity and, an extension to three to four weeks an additional magnitude of improvement. After extension of experimental duration to four weeks however, an active debate in the life sciences community continues as to whether further incremental increases, short of three to six months duration, would be of sufficient significance to warrant the effort. All changes in mission length will lead to increased requirements for the support of the experiments in the Baseline Data Collection Facility (BDCF) and Life Science Support Facility (LSSF) at KSC. Longer duration missions could also impact, by compression, the medical operations support requirements unless the current flight schedule was adjusted

to lengthen the interval between flights. The desire to maintain the flight schedule could also result in additional work loads for ground personnel to meet the schedules for refurbishing the shuttle vehicles and for processing the payloads. This increased work load could have an additional impact upon the Occupational Medicine and Environmental Health Program.

4.4 Crew Size And Makeup

Crew size for all currently scheduled flights range from four to six beginning with STS-5. Proposed crew makeup also remains rather constant with the Mission Commander, Pilot, Mission Specialists and/or Payload Specialists providing the basic flight crew. Recently, addition of a medical crewman has been made for STS-7 and STS-8 as a response to answering questions about "space sickness." Planning should recognize that the trend to adding more crewmen will continue to the maximum capacity of the STS vehicle, seven.

With the present planning, it is NASA's position that the flight population will remain as one that has been quite well defined for STS mission lengths. Crew effects in missions of this length are judged to be well documented and supported by a rather reliable data base. It is believed by NASA that this data base adequately reports what adaptive events will be seen, importance to mission conduct and success, and the ability of the crew as a population to handle the adaptive events.

The recent flurry associated with the "space sickness" issue perhaps raises questions about this position. A commitment to longer mission lengths, suggested above, could ease the time-line work schedules for the crew if the mission payloads and goals are retained. This could also ease the concern about the initial adaptive events interfering with the conduct of experiments at the beginning of the missions.

However, such gains could be quickly offset by increasing the crew work load assigned for each mission. The major impact that increased crew size could have upon KSC, if the flight manifest (after 1983) is followed, is the ability to house and support the number of crew members who will be at KSC at any one time while they are preparing for a flight, and, the capability of the KSC medical staff to be able to support a series of prelaunch medical checks, the research sample processing and experimental support in the BDCF and LSSF. The assignments of additional flight crew members and/or an increased number of flight experiments could markedly increase the life sciences and medical work load and the use of the facilities.

An increase in mission duration would make the inclusion of more efforts in science, engineering and manufacturing, etc., more attractive during each flight. Increasing the flight objectives and experimental program could accelerate the schedule for enlarging the crew and in turn levy increased demands upon the LSSF and BDCF. For example, the United States Air Force (Air Force) has expressed an

interest in using available life sciences facilities at KSC where they can be made available. They have outlined a rather ambitious program to study man from a medical, physiological and behavioral (man-machine) point of view. They are the first life sciences group to express an intent to use carry-on and mid-deck experiments to any degree. The USAF program may present some problems with reassuring security for some of their experiments during the experiment preparation and postlanding; an issue that needs clarification between NASA and DOD.

Longer missions could also open the opportunity for the flight of elective passengers, a topic that has been discussed extensively by NASA and other groups over the past decade. A decision to carry elective passengers would place special demand upon the overall NASA medical support system since there is currently no in-house experience or data base that could be applied in the medical evaluation of such a group in determining their relative health risks and safety for flight.

4.5 Crew Support At KSC

As the tempo of flight operations increases in late 1983, the intensity of the activities associated with payload buildup and integration also will grow greatly. Previous manned spaceflight programs have shown that during the experiment buildup, integration and checkout, many changes are required to get the payload prepared for flight. The buildup of activities on Space Laboratory 1 is

following this same course. Although it is a goal within the payload processing team to standardize and make payload preparation more routine, it can be expected that there will be a continuing need for changes for the foreseeable future. Certainly this will be the character of carry-on or mid-deck experiments which can be expected to change on each flight. The USAF has suggested that this class of experiments will probably be their primary mode of research for life sciences during the next few years. As a result there is general agreement by those with experience in payload preparation that this will result in increased numbers of crew members being at KSC for longer periods of time, especially the mission and payload specialists, to keep them abreast of what changes are being made and to participate in the decision process of change. How much increased crew participation can be expected has still not been determined by NASA or the USAF. This is an urgent area for discussion between KSC, JSC and the USAF managements since it could affect long lead procurement, construction, and preparedness to support this crew in residence requirement for future STS operations. The overall plan for the support of DOD crews at KSC will still require detailed discussion and agreements to be drawn to establish what will be expected from KSC.

As a result of increased visitation at KSC by the crew, the aerospace medical support of the crew members while at KSC should become an increasingly important support function. Initially one might project that these visits by the crew will continue the past practice of having the JSC Flight Surgeon accompany them. However,

the frequency of the visits by the crew and the multiple mission assignments of each JSC Flight Surgeon will tax their capability to support the crew members. This will probably cause them to seek increasing assistance from the KSC Biomedical Office to cover the medical needs of the crew during their KSC stay.

Prudent medical planning by KSC would project that there will be an increasing request of KSC for providing medical resources during the transition year and into the accelerated mission pace. One need only to assume that the successful delivery by KSC on these initial requests will result in a further extension of the dependence upon the KSC medical staff for additional operational functions. This process should be expected to be evolutionary but will eventually result in KSC being tasked to provide most of the routine support activities for all medical operations that occur at KSC. The requests will include the provision of the facilities, use of KSC laboratories, and for the assumption by the specialized professional staff at KSC of the operational responsibility for the routine events that were previously handled by the staff of JSC. Such a shift would reduce the numbers of people required to travel back and forth between JSC and KSC and would better utilize the resident medical and scientific staff at KSC.

It is recommended that the Biomedical Office establish as a planning goal the acceptance of an evolutionary transition of the routine biomedical operational activities to KSC. Careful planning for this transition will assure a continuation of the reliable medical

operations that NASA has come to expect, yet obtain increased efficiencies in the use of biomedical resources, including personnel, and a reduction in overall medical support costs per mission.

Early discussions should be conducted between JSC, the USAF, and KSC to lay out the future course of medical operations and the provision of aerospace medical care for crew members while they are at KSC. In a similar vein, it is urgent that a detailed set of medical requirements be developed for the medical support of prelaunch, launch, flight related, and postlanding needs. These discussions should keep in mind the possible changes in crew size, crew background and origin, mission length, and the common needs of all who will be conducting human research in flight. A by-product of the requirement definition efforts should be the identification of common facilities and provisions that can serve all mission activities. By this, KSC will be able to plan and provide an efficient and flexible set of resources for flight support.

4.6 Visitors To KSC For Launch And Landings

Visitor related activities associated with the STS flight schedule also have special implications for medical support. A review of the current planning for visitors at launch and landing events is discussed below.

Planning of the KSC Public Affairs Office (PAO) will continue the extensive guest invitational program to each launch through the STS-9 (Space Laboratory 1) mission. It is expected that after this event, in the fall of 1983, the level of interest by the press and invitees will begin to wane since the flights will have become more routine and repetitive. This decrease in the number of the invited guests is projected to occur at about the time that there will be an increase in frequency of flights to one per month.

It is planned that as the number of invited guests attending decreases, some of the viewing sites will be either closed or turned over to the Visitors Information Center (VIC) contractor for use as an additional feature of the KSC visitor program. This would allow the number of guests to be limited or opened as NASA would desire for any given launch event. Medical care for those attending a launch through the VIC would be similar to that provided for visitors to KSC today, only as the VIC contractor sees a need. It is even reasonable to consider providing such services on a cost reimbursable basis from the VIC contractor. The projected number of visitors for future launches is summarized in Table 1.

Table 1. PROJECTED NUMBERS OF VISITORS FOR LAUNCH INCLUDE:

	<u>VIP</u>	<u>PRESS</u>	<u>OTHER VISITORS</u>
Presently	5000-6000	1500-2000	30,000-40,000
Projected	1000*	500-700*	15,000-20,000**

* - Expect to merge the VIP and press into one site of 1500-2000 capacity; the other sites will be turned over to the VIC contractor.

** - This is the maximum size of the causeway sites. This can be reduced now or after Space Laboratory 1 mission as a means of improving traffic flow between KSC and Cape Canaveral Air Force Station (CCAFS) during a launch operation. •

The initial landings of the STS vehicle at the KSC also is expected to produce a high level of visitor interest and attendance. Although the flight at which this will begin is still being discussed (presently forecasted for the end of STS-7 mission), it is expected that it also will occur on or before the increase in frequency of flight in late 1983. The PAO is planning to extend invitations to guests to attend the initial landings. Present projected facilities will accommodate between 4,000 to 5,000 at the formal viewing site. If the level of interest in attending landings warrants added accommodations, it is proposed by PAO to establish an overflow site that will use space in the open areas managed by the U.S. Fish and Wildlife Service at KSC. The overflow sites will have only minimal communications capability. Medical support of these events at both the formal and overflow sites will be expected in a similar manner to that provided at launch viewing sites. The overflow sites will be closed as soon as the interest in attending landings drops sufficiently to bring the number of guests to within the capacity of the formal site. At a point in time when landings become routine, and invited and press attendance wanes sufficiently, it is the PAO opinion that it will turn the formal site over to the VIC contractor as an additional attraction. Again, at that point, any medical support needs will follow existing arrangements with the VIC contractor and reimbursement for services could be considered.

DOD Mission Impact

DOD missions to be flown from KSC also increase in number beginning in 1983. Although the NASA/DOD relationship from a medical operations support point of view has not been finally defined through a joint agreement, discussions indicate that the DOD, at a minimum, will seek to use the NASA missions as a means of training DOD medical personnel until the actual agreement has been signed. In any case, a major portion of the medical support for the flight operation, and particularly the emergency medical support system for KSC/CCAFS, can be expected to be used. Occupational medical support for critical or hazardous events during the launch preparation period will be provided by the KSC base operations contractor.

Decisions concerning the housing and medical support of the DOD flight crews needs to be made. For planning, the same rules as far as crew avoidance of contacts with diseases, limits on access, etc., are equally important for DOD crews and missions as that provided for NASA flights.

The DOD is just now beginning to form their plans for conducting life sciences research on missions. Their initial planning indicates an ambitious program of carry-on and mid-deck experimentation. Primary work will be done on the ground with in-flight confirmation of the ground results. In the event they seek to perform such studies, it is doubtful that their requirements will be different than those arising from experimenters on NASA

flights. Problems of inclusion of the DOD experiments into the LSSF or BDCF would be ones of scheduling and security. Since their life sciences experiments would be coming from DOD laboratories, there may be a requirement for more support at the KSC life sciences facilities than has been the experience with NASA centers who have conducted or sponsored experiments in the past. Clarification of their plan for experiments and their use of KSC life sciences facilities is urgently needed. Their initial experiments are now forecast for flight on STS-10.

Recommended guideline for medical planning is to expect the DOD to draw upon the NASA resources now in place at KSC for supporting the launch and landing phases of the mission. NASA medical staff should establish whether such a support effort will require NASA medical teams to become security cleared for the mission payloads if they will be expected to provide medical care, launch and landing medical support, including the EMSS activities.

4.8 Expendable Launch Vehicles

The available schedule for the launch of ELVs from KSC and the CCAFS indicates between eight to eleven launch opportunities per year through 1986. Medical support for ELV launches is minimal and generally confined to supporting critical phases of the countdown. It is noted on current schedules that an option remains to use the STS vehicle as an alternate to the ELV for most of the flights after the third quarter of calendar 1984. Another option, the transfer of

these launches to privately operated space launch companies, is also being studied. Prudent medical planning would project the use of the space shuttle as the most likely alternate to the present operation. This will ensure that this activity has been folded into the medical plans. If the private approach prevails, these plans can be easily deleted. If not included as a shuttle payload option now they could easily become lost. If this shift to the use of the shuttle occurs, the ELV program would be reduced drastically after mid-1984.

For medical planning, it is suggested that the eight to eleven ELV missions per year be considered baseline for medical support planning at this time but with full expectation that the requirements for this support probably will be markedly reduced when these payloads are transferred to the STS program beginning with mid-calendar 1984 and beyond. Such a transfer of payloads may place an increased demand for different mission durations and for additional payload specialists on a mission.

This approach is not unreasonable because medical support for ELVs is limited. Although these require only a minimum of medical resource commitment, examination of the need for and level of present medical provisions are warranted to see if experience supports the need for the commitment of a medical team and ambulance to be on the scene for all of the present prelaunch events now calling for these provisions.

Completion of the flights now on the manifest will establish the KSC as an operational spaceport. One would be short-sighted if it were assumed that a similar schedule would not be continued after 1986, perhaps with longer flights, or with variable mission lengths, and with a different crew makeup on each mission. If a national commitment to build a space station is not made, this assumption would appear very reasonable.

Even if a national commitment to build a space station is made, the frequency of launch probably will still continue at least at the current rate reflected in the referenced flight manifest. The flights will be needed to construct, resupply, exchange station crew and service the station during the initial phase of station operation. Payload makeup and the number and types of crew and passengers could be expected to change as a reflection of the various stages of construction and operation of the space station facility. Longer periods between flights to the station may be attained after the station has been fully activated and its operation has settled into a routine.

In either scenario the operational flight activities at KSC will lead to the further maturation of KSC as the spaceport for most non-military and some military operations. KSC will serve a key role in the transfer of this major NASA program from an DDT&E to full operational state. KSC will play a major role in the

development of the requirements, policies, and the facilities that will be needed for the mature program. KSC will serve as the reference model for the development of its related Spaceport (West) at VAFB.

A part of the development of the spaceport will be the establishment of the supporting medical programs to service the facility. The biomedical programs will include the usual Occupational Medicine and Environmental Health Program that is needed for such an institution and a number of additional special efforts to include: the crew support aerospace medical program, the crew launch and landing support programs, the non-human and human experiment support program, and the inter- and intra-NASA center research and development activities. For planning purposes, it should be expected that KSC will be asked to assume as much of the crew and flight experiment support work as it is willing and able to assume. The requests levied upon KSC will parallel the movement of the flight operation to a more routine nature. It should be anticipated that oversight of these efforts will be retained by the NASA lead center, primarily JSC and ARC.

As the assignments of this work to KSC proceeds, KSC will need to readjust its management philosophy from one of providing support for each flight program as an entity within itself to one of building toward general capabilities needed for future more permanent, continuous operations. This philosophy must also include long-ranged biomedical planning and a program for providing an

upgrading of the biomedical operations as requirements change or technology advances warrant.

Recasting the present biomedical operations to meet the support of the shuttle operational era represents a challenge for the Biomedical Office. Earlier manned flight programs and the initial DDT&E flights of shuttle have provided a rich base of experience from which to draw. This experience, however, is based upon short-termed KSC operations from flight programs with limited life times. The KSC Biomedical Office must be prepared to implement those portions of the requested pre- and post-flight activities as the requirements for medical operations are defined by JSC or the DOD. To this end, it is recommended that KSC assume a posture of being prepared to accept responsibility for the conduct of all phases of the flight that will be performed at KSC as it is offered. If a total commitment will have some limitations, it is important for the KSC Biomedical Office to make decisions as to what the limits will be. For areas of work that they expect to be able to perform, they should establish a schedule as to when they would expect to be ready to assume the work and over what period KSC would need to have as a period of transition. For planning purposes it is recommended that KSC assume that they will be asked to eventually undertake all of the routine medical activities in the pre- and post-flight periods.

The amount of past KSC experience that may be applied to planning for the life sciences facilities and the support of the research

investigators is much more limited. Such experience in life sciences within NASA has been previously concentrated at the JSC and ARC. The non-human experiment support area (LSSF) is nearing completion following a vigorous joint ARC/KSC effort. The LSSF should permit the KSC Biomedical Office to be fully ready to meet the needs of the non-human life sciences research investigators for the foreseeable future. The only remaining question is whether this activity will also be able to meet the total requirements for the support of carry-on and mid-deck experiments. This concern should prove to be of a minor nature due to the inherent flexibility that has been built into the LSSF. Presently the concern is more related to the lack of detail on what these experiments will be and how many will be flown on any one mission. Present planning for the LSSF operation includes an excellent scheduling system which should permit the use of the built-in flexibility of the facility design that will be needed to accommodate these experiments.

In the human experiment support area the issues remain much more complex. The definitions of what will be required as far as facilities, technical capabilities, and expertise at KSC have not been documented. The definition of these requirements and a decision on the role of KSC in meeting these requirements is urgently needed. Present planning addresses only one flight at a time. Again, if one applies the concept of KSC serving as Spaceport (East), one might expect that KSC will be required initially to provide facilities and their operations as the very minimum required for the support of the human experimentation. More likely, KSC will

be asked to undertake increasingly all of the routine activities that will be needed for such efforts. It is recommended that an urgent joint JSC/KSC effort be undertaken to generate a requirements document for the human experiments program. This document should be similar to that developed by ARC/KSC for the design of the LSSF. This effort should result in a general requirements document, including the agreed upon schedule when the requirements will need to be provided. Again it is recommended that KSC assume a posture of being willing to assume responsibility for providing routine support as it will be offered for transfer from JSC, and to provide support as requested by the USAF. In this latter case, this posture may be of special importance to the planning for the support of human experiments proposed by the DOD since the DOD does normally depend upon the host center for routine support of activities to the maximum possible.

In summary, the concept of KSC serving as Spaceport (East) requires good long-ranged planning. This will require an overall shift in philosophy of KSC management toward the creation and operation of a permanent operational flight facility. The long-standing concept of providing support for a project during its relatively short stay at KSC and then starting afresh on the next project should be replaced by an approach that would build and operate what a spaceport will need to provide over time. The biomedical programs also need to accept this philosophical change as part of the overall change to KSC becoming a spaceport. A long-ranged biomedical program plan is

needed to ensure this program's readiness to fit into overall KSC future operations. Previous solutions to support requests should be looked at as interim with expectation that may require being replaced with long-termed and general solutions.

4.10 A Summary Of Medical Impact Of Shuttle Flight Model

A Summary Of Medical Impact Of Shuttle Flight Program, contained in Chart 1 is recommended for use in future planning and programming for its medical and life sciences program.

Chart 1.

A SUMMARY OF MEDICAL IMPACT OF SHUTTLE FLIGHT PROGRAM

	1983	AFTER 1983
LAUNCH FREQUENCY	FLIGHT INTERVAL 1 FLIGHT / 3 MONTHS 4 FLIGHTS / YEAR	FLIGHT INTERVAL 1 FLIGHT /MONTH (MIN = 0.5 MO; MAX 1.5 MO.) LAUNCH FREQUENCY WILL REQUIRE DEDICATED MEDICAL OPERATIONS SUPPORT TEAM.
LANDING AT KSC	STS-7 INITIATION	ROUTINE AFTER STS-9 (OCTOBER 1983)
MISSION DURATION	5-7 DAYS MIN - 3 DAYS; MAX - 9 DAYS (STS-9)	5 - 7 DAYS AVERAGE; EX- PECT MISSION EXTENSIONS (AS WAS DONE ON STS-9) WITH ADDED FLIGHT EXPE- RIENCE AND/OR DELAY IN DECISION ON SPACE STATION. MISSION EXTENSION TO 2 WEEKS OR 3 WEEKS NOT UN- REALISTIC. 4 WEEK MISSION EXPECTED TO BE MAXIMUM MISSION FOR STS.
CREW SIZE	4-7 CREW MEMBERS ALL NASA SELECTED	4 - 7 CREW MEMBERS. ANTICIPATE ADDITIONAL MIS- SION AND PAYLOAD SPECIALISTS TO BE ADDED. BE PREPARED FOR POSSIBLE ADDITION OF NON-MISSION RELATED PASSENGERS.
CREW SUPPORT	PROGRESSIVELY MORE IN- VOLVEMENT OF KSC BIO- MEDICAL OFFICE IN CREW SUPPORT	KSC WILL HANDLE LAUNCH AND LANDING RELATED MEDI- CAL CARE AND OPERATIONS AND HUMAN EXPERIMENT SUPPORT. EXPECT REQUEST FOR INCREASED CREW CARE WHILE AT KSC FOR CREW MEMBERS BETWEEN MISSIONS.

Chart 1. (page 2 of 3)

VISITORS AT FLIGHT
EVENTS

THROUGH STS-9/FLIGHT
30,000-40,000 VISITORS
5,000-6,000 VIP VISITORS
1,500-2,000 PRESS

NEGOTIABLE - VISITORS
INTEREST WILL DROP OFF
AFTER STS-9. 1,000-
1,500 VIPS AND PRESS

BEYOND STS-9 15,000-
20,000 VISITORS 1,000
VIP VISITORS 500-700
PRESS

ASSIGNMENTS OF UNUSED
VIEWING SITES TO CONTRAC-
TOR FOR KSC VISITORS IN-
FORMATION CENTER.

DOD PARTICIPATION

TO BE DEFINED AS TO
NUMBERS OF PERSONNEL
SKILLS/FACILITIES THAT
WILL BE AVAILABLE FOR
EACH FLIGHT BEYOND THAT
REQUESTED FOR TRAINING
AND GAINING EXPERIENCE
BY DOD.

TO BE DEFINED AS TO ROLE
AND RESOURCES AVAILABLE/
FLIGHT. TRAINING AND
EXPERIENCE SOUGHT BY DOD
PERSONNEL IN PREPARATION
FOR DOD OPERATION AT VAFB
(MID 1985). AMBITIOUS
"CARRY-ON" MID-DECK EXPER-
IMENTS PROGRAMS WILL BE
CONDUCTED. REQUEST FOR
EXPERIMENT SUPPORT SHOULD
BE EXPECTED BY KSC.

EXPENDABLE LAUNCH
VEHICLES

8-11/YEAR

8-11/YEAR THROUGH MID-
1986. AFTER MID-1984
EXPECT THESE OPPORTUNITIES
TO BE SHIFTED TO SHUTTLE
RATHER THAN ELV. SOME
LAUNCHES MAY BE GIVEN TO
PRIVATE INDUSTRY.

Chart 1. (Page 3 of 3)

SPACEPORT (EAST)
(OPERATIONAL SHUTTLE)

USE PERIOD BETWEEN STS-6 AND 9 AS TRANSITION PERIOD FOR MEDICAL OPERATIONS. HAVE OPERATIONS CONFIGURATION PLANS COMPLETED BY END OF STS-9. IMPLEMENT OPERATIONAL MEDICAL PLAN ASAP AFTER STS-9.

THERE WILL BE LIMITED SUPPORT REQUIRED FOR LIFE SCIENCES FLIGHT RESEARCH EFFORTS DURING STS-6 THROUGH STS-9. EXPECT INCREASED NUMBER OF CARRY-ON EXPERIMENTS TO BE PLANNED, ESPECIALLY FOR OPERATIONAL QUESTIONS, i.e., "SPACE SICKNESS" AREA. STS-9 (SPACELAB 1) OFFERS FIRST OPPORTUNITY TO EXERCISE KSC LSSF. STUDENT EXPERIMENT SUPPORT WILL CONTINUE.

INITIATE PLANNING FOR LONG TERMED MEDICAL AND LIFE SCIENCES NEEDS AT KSC TO MAKE KSC - SPACEPORT (EAST). IN PLANNING, ACCEPT PRESENT OPERATIONAL PROVISIONS AS INITIAL REQUIREMENTS. DRIVE PLANNING TOWARD LOOKING FOR A PERMANENT SOLUTION TO FUTURE NEEDS AT KSC.

MEDICAL OPERATIONS PROGRAMS WILL BE "TWEAKED" FOR IMPROVED EFFICIENCY. KSC PARTICIPATION IN MEDICAL OPERATIONS WILL BE LIMITED ONLY BY KSC ABILITY AND WILLINGNESS TO PERFORM EFFORT.

DEDICATED LIFE SCIENCES PAYLOAD SUPPORT EVERY 18-24 MONTHS AND FREQUENT, MULTIPLE MID-DECK AND CARRY-ON PAYLOADS WILL REQUIRE SUPPORT ON MISSIONS BETWEEN DEDICATED MISSIONS. SUPPORTING DOD CARRY-ON, MID-DECK EXPERIMENTS WILL MARKEDLY INCREASE. STUDENT EXPERIMENTS SUPPORT CONTINUES, HOWEVER, KSC MAY HAVE TO PROVIDE MORE EXPERTISE FOR STUDENT EXPERIMENTER.

COMPLETE AND EXTEND MEDICAL PLANNING TO REFLECT LONG TERM NEEDS OF NASA AND PROGRAMS TO BE DONE AT KSC. DEVELOP DECISIONS WITH KSC MANAGEMENT, NASA HEADQUARTERS, OTHER KEY NASA CENTERS AND PROGRAM OFFICES TO ENSURE THAT LONG TERMED PLANNING FOR KSC MEETS WHAT NASA WILL NEED AND CAN BE PROVIDED AT KSC.

5.0

Biomedical Impact Of Future Flight Operations

The transition of the space shuttle program into its operational phase offers an opportunity to reassess the policies procedures and program content of the present medical operations to see if there has been sufficient experience gained to permit the revalidation of current activities or to provide a basis for adjusting the program. The manager of Medical Operations at NASA Headquarters views 1983, or through Space Laboratory 1, as a period of analysis, adjustment, and transition for the STS medical operations from the DDT&E era to that required for the routine operational era. This reevaluation should draw directly upon the experience gained from previous flights followed by the interpretation of this experience to future mission requirements. The subsequent sections discuss the experience that has been gained, its relationship to what is now projected, and what might be expected to occur as more flight experience is gained.

5.1

Changes Beginning With STS-5

The transition period started with the planning for the STS-5 mission. Changes instituted for STS-5 and subsequent flights include:

- A. A reduction of the numbers and the magnitude of the pre- and post-flight medical examinations. The medical examination program will be confined to a single intensive examination on F-30 days and one or two abridged checks thereafter prior to

flight. Postlanding examinations will also be abridged over previous missions. Only an immediate postlanding quick-check and a L + 4 day examination are scheduled. The L + 4 day examination primarily is to determine the readiness of the crewman to return to full flight status rather than serving as a means for developing further information for the data base on man's adaptation to space and his return to the one "g" environment. The timing for postlanding examination was selected on the basis that it took a three-day period to permit previous crew members to readapt to the earth gravity environment. Other checks could be added after the L + 4 examination if the medical findings indicated that the preflight physiological levels had not been reached or if other medical questions or special examinations as part of the research experiments remained.

The major preflight and L + 4 day examinations will continue to be conducted at the JSC. The cursory preflight checks could be conducted wherever the crew member is when it is due. The net result is that a reduction in the amount of pre- and post-flight medical examination activities at KSC will be expected starting with STS-5 (and continued through STS-6).

This decision to reduce the number and magnitude of the medical examinations, before and after flight, has been made based upon the conclusion that there is a sufficient data base on seven-to-ten day spaceflight missions to document the adaptive processes expected during such mission lengths. This data base

is judged by NASA to be sufficiently well defined to permit the operational impact of these changes to be ascertained. Since most STS missions from STS-5 to the late 1980s are projected to be of ten days or less, little surprise is expected. Therefore, examinations will be directed toward establishing the health status of the crew member for the upcoming flight and to develop the backdrop for interpreting any unusual event if it was to occur during a mission.

At the same time, a formal program, centered around the comprehensive annual medical examination of all NASA crew members for flight certification, has been initiated to collect longitudinal data on the health status of those selected as astronauts. It is proposed to bring all current and previous astronauts into this study thereby capturing physical, physiological, and laboratory information on all who have been chosen through the selection process, training, flight, and the post-flying period of their career. The format and content of this longitudinal study have been approved.

Any pertinent medical events that occur between annual examinations will be incorporated into the longitudinal data system. The F-30 days and postflight evaluations also will use this data base on each crew member as the point of reference for determining a crew member's medical readiness for flight and return to flight status after the mission. The annual medical

evaluations will be conducted and the resulting data base managed by the Director of Space and Life Sciences, Medical Operations Group at the JSC.

B. A reduction was made in the level of magnitude of the Health Stabilization Program for STS-5 and subsequent flights to a Level I, Health Awareness Program. The Health Awareness Program is voluntary. It includes the astronauts, their families, and any workers to whom they may be directly exposed during the last week prior to the flight. Its goal is to reduce the exposure of the crew to an infection during the period prior to flight that could manifest itself during the flight. All will be educated on the problems arising from an exposure of the crewmen to a disease process, what can be done to lessen the risk of infection, the meaning and significance of incubation periods after exposure, and the risk of such an infection to the mission. All involved will be requested to take precautions voluntarily to reduce the exposure of the crewmen. Of importance to the Biomedical Office, this change should reduce the required overall KSC medical support effort. If future missions are extended, the decision to reduce the level of control that was initiated with STS-5 would need reexamination. Missions of two weeks and beyond could be seriously threatened by illnesses that are caused by organisms with longer incubation periods and could occur in orbit.

C. The appointment of a backup crew for each flight is being discontinued. If a crew member develops a problem that requires his withdrawal from the crew, a one for one substitution will be made (i.e., Commander or Pilot replaced by another qualified Commander or Pilot; Mission Specialist by another qualified Mission Specialist, etc.). This mode of crew change might have an impact upon the level of activity at KSC depending upon when the problem causing a crew member to be withdrawn occurs. The replacement, during the last thirty days before a mission, will have to be placed upon an accelerated schedule of special preparation for the mission and be cleared for flight medically. Probably the initial medical approval for flight of the substitute crew member will be done at the JSC; however, since such a change can occur at any time prior to flight, KSC may be required to provide facilities and support of the JSC Mission Flight Surgeon, or act as his backup Flight Surgeon as the medical clearance process is completed. The elimination of backup crew will tend to reduce overall medical operations and flight crew support work load at KSC. This area is one that could require future KSC attention as the flights become more routine and more frequent. The chance for needing to replace a crewman will increase with the increasing frequency of flights. A decision needs to be made as to whether JSC crew surgeons will be accompanying the crew to KSC for all the preliminary activities or whether the local aerospace medical program could be requested to perform this function.

D. Starting with STS-5 and continuing throughout next year there will be an increasing involvement of DOD medical personnel in the activities surrounding a flight. The DOD participation could serve as an additional source for providing depth to the medical capability at the launch site, landing site and mission control phase of the mission. At the same time, through the involvement of the DOD medical personnel in actual mission activities, the DOD will gain the training and experience they are seeking. This will permit them to obtain the trained medical cadre they are seeking in time for the first DOD launch of STS at VAFB in 1985. The DOD requirements for the medical support of DOD flights to be launched from KSC is still unclear.

DOD has recently offered to provide the medical training for all of the personnel who would be involved in the initial treatment, triage, stabilization and transport of an injured crew member. No decision on this offer has been made. The DOD is also open to discussions on the use of more DOD biomedical personnel and facilities for intermediate and definitive care of injured crew members. The initiative for obtaining this additional support rests with NASA.

5.2 The KSC Emergency Medical Support System For The Flight Crew

The shuttle EMSS represents the composite experience gained from all launch area medical support efforts that have been provided to previous manned spaceflight programs. This experience has been

revised to reflect the special risks that were identified by analysis that might occur with the shuttle system. A comprehensive EMSS plan has been used beginning with the initial flight since each flight of the shuttle was to be manned and it was recognized that the flight of the space shuttle incorporates the complexities of both a new spacecraft and a new aircraft. Intensive planning and training of the EMSS team for each launch has been performed. Changes in the EMSS have been minimal to date and those that have been made were done to smooth the operation rather than revise the EMSS.

The DDT&E flights have been successfully completed. Valuable experience and confidence in the shuttle launch system has been gained. The declaration of the shuttle system as operational can be equated to a new passenger aircraft receiving its flight certification from the Federal Aviation Administration. Subsequent to receiving a flight certificate an aircraft can be made operational, a plateau that allows that aircraft to begin carrying passengers or carry freight and to be assigned to routine airline operations. The STS vehicle has now completed its first operational flights, STS-5 and 6, successfully. These flights were made without ejection seats, with two additional crew members and without pressure suits being worn by the crew members during launch. These major operational changes aptly testify to the degree of confidence and maturity which the engineers and mission operations people believe the STS system has achieved.

Through these changes the STS program is committed to the premise that any survivable emergency on the pad during the launch operation will be handled through egress from the cockpit and escape to the ground. During a launch an emergency will be met through the safe return of the shuttle vehicle to the Shuttle Landing Facility (SLF). This approach to the handling of vehicle emergencies sets the boundaries for the requirements for the EMSS during the operational era.

The continuation of the slower pace of launches for most of 1983 and the initiation of landings at KSC during this slower pace of launches will permit the collection of valuable experience with the EMSS during additional operational missions before the tempo of launches and landing events increases. The interval between flights during this period will remain at approximately three months through STS-9 (Space Laboratory 1), although shorter periods between missions are now envisioned following the delay in the launch of STS-6. After STS-9 the intervals between launches drops to between 0.5 to 1.5 months, a pace that will permit little opportunity for making changes before the support of the next flight is begun. This rapid rate of flight of the STS is scheduled to continue throughout the remainder of the present manifested flight program.

Of equal importance, the flights scheduled through STS-9, the transition year, are characteristic of the flights that are now scheduled on the present flight manifest. The additional experience that will be gained from flights during the transition period could be most valuable in forming the final operational configuration of the EMSS.

A delay in implementing the final configuration of the EMSS until after STS-9 will provide an opportunity for the DOD to further develop its shuttle medical planning. They will have been gaining training and experience for their personnel during the NASA flights. It will permit additional time for further NASA/DOD negotiations as to what their continuing role will be on each NASA and DOD mission. It also will provide a sufficient interval of time to complete definitive discussions with local medical institutions and the Shands Medical Center at Gainesville, Florida, regarding their ability and willingness to provide the resources that will be required to meet the flight schedule of one to two launch and landing operations per month after STS-9.

Other important changes in the level of medical operations support could be incorporated by the end of the STS-9 mission. The continuing review of the level and amount of medical support provided for each major test and checkout event during the preparation of the launch system already has resulted in the reduction in the number of events requiring on-site medical support. Other checkout events have been reevaluated, using the experience gained to date, and have resulted in an appropriate reduction in the level of the on-site medical support. These reviews are recommended to continue with the goal of identifying what is needed rather than what has been traditionally provided. Change should be proposed that reflects a recognition of the continuing maturation of the launch and flight systems and procedures. Reductions in the amount and level of medical resources provided can free up for reassignment critical resources that will be needed to meet the accelerating flight schedule.

Under section 5.4 it is also suggested that the amount of support being provided for visitors during a launch and landing can be reduced to reflect the expected reductions in the number of sites to be covered and the level of medical support at each site. It is suggested that revisions in the amount and level of care provided at each visitor site can be made now based upon the experience to date on numbers of patients seen and their reasons for seeking medical assistance. A draw down of medical resources now assigned to the visitor programs could free up resources that could be made available for assignment to the EMSS for launch and landing support. Planning a reduction in traffic congestion on major KSC roadways during launch and landing events would permit the use of a "call-up" system of medical support for the visitor sites and the use of ground vehicles for the transport of any visitor who became ill or injured. These options should adequately offset the reduction in the amount and level of medical support on the visitor site.

The availability of these additional resources for assignment to the support of the flight events and the capability to use the ground based vehicles more efficiently will offer an improved in-house capability to meet the increased frequency of the launch and landing events in the future with the same personnel levels.

A further opportunity for improving the use of the time of the EMSS team between missions would be the examination of the training programs now performed prior to each flight to see if these exercises could not be conducted during non-critical times between

launches and a "walk-through" if deemed necessary just prior to any given mission. Since flights will become more routine, good general training may be more attractive than the mission to mission scenario now being used. Further economics in time and effort might be obtained if the same team members could be maintained for several flights. Once a team member has been fully trained and certified as to his/her readiness, the objective for future training and the use of training time should be directed toward providing refresher training or training on any changes in procedure or equipment. The more of the EMSS activity that the KSC/DOD staff can handle in-house, the better the EMSS will be in meeting the demands of the accelerated launch and landing schedule. The in-house staffs, government and contractor, should strive to be prepared to handle all of the local area contingency problems, up through the transport of the casualty to the local facilities (i.e., Jess Parrish Memorial Hospital, Patrick Air Force Base Hospital, etc.) and the definitive care facility (i.e., Shands Medical Center). This can ease the problem of these outside medical institutions that would result from continuation of their present posture of dedicating a fair portion of their emergency capability to mission readiness. At the same time they can be asked to remain available if and when their institutional capability is needed.

5.2.1 Conclusions And Recommendations:

- A. Use the period through STS-9 to further collect additional operational experience with the current EMSS. This will permit

gaining additional flight experience on a new shuttle orbiter, the new operational flight procedures, and to discuss and incorporate with DOD their plans for participating in NASA STS operations.

B. Maintain the current EMSS plan for crew recovery and care and launch team support for the period through STS-9. Establish the launch and landing support EMSS team as a separate entity from that providing care for KSC visitors during these events. The separation of the EMSS for flight operations from visitor care is recommended for separate consideration because the tasks expected of them are specific, unique and are of a field operations nature. The personnel assigned will need special training in emergency and trauma medicine. Proficiency in these unique talents must be maintained. Schedules for flights will require this EMSS team for the launch and landings to be committed to this effort for a major portion of their duty time and little opportunity for assignment to the routine Occupational Medicine and Environmental Health program. To meet this mission need NASA can ask the BOC medical staff to meet the operational needs or to negotiate the added and dedicated support from the DOD, or augment the Biomedical Office staff. The BOC Medical team should be able to handle the visitors support from its regular staff. It is recommended that current flight support provisions be revised during this period of transition only as additional experience shows that the proposed provisions will maintain or improve the medical risk/benefit situation for crew recovery and/or improve the boundaries of what constitutes a survivable emergency.

- C. Modify current commitments as needed to meet the NASA commitment to train DOD personnel.
- D. Improve the capability to handle KSC/CCAFS EMSS requirement in-house (i.e., NASA, OMEHS contractor, DOD). Incorporate this commitment into the NASA/DOD Medical Operations Document that is under preparation. Establish agreement as to time to incorporate the new joint NASA/DOD EMSS operation into place. Assure readiness to incorporate DOD into the EMSS in time to meet the increased tempo of launches and landings at KSC.
- E. Draw upon NASA OMEHS contractor resources for direct flight support. Request the OMEHS contractor augment his staff as needed to support the launch and landing events in the post-STs-9 period. This could become of major importance in the event the DOD or the local medical community cannot maintain the present levels of commitment during the forthcoming accelerated flight frequency. In anticipation that there will be a need to use additional KSC resources in the direct support of a launch and landings, use the flights through STS-9 to gain more efficiency from current resources through the readjustment of resource commitment to the visitor program (i.e., consider going to a single Emergency Medical Technician or Paramedic at each visitor site). Implement a radio "call-up" system to cover the situation where additional assistance is needed. This could reduce the number and mix of medical resources committed to the operation for each mission yet keep a full care system available if needed.

It will permit deployment of medical resources where they are needed when they are needed.

F. Use the transition period to prepare the EMSS system for the post-STS-9 missions. During this period collect the data that will be needed to permit recasting of the EMSS (i.e., impact of the increased frequency of launches and the addition of landings within one week after each launch; details on the ability and willingness of DOD and area medical facilities to commit resources to meet on the proposed schedule of flight; the possibility of using a "standby" or "on-call" EMSS approach rather than the "on-station" EMSS presently used, etc.).

5.3 Emergency Medical Support System Integration with the Medical Disaster Planning for KSC and CCAFS

A delay in revising the EMSS until after STS-9 has landed will permit the completion and revision of the KSC and CCAFS disaster plans before the final changes of the EMSS are made. The increased tempo in launches and landings, to an average of one per month after late 1983, offers the greatest potential for requiring the activation of portions of the disaster plans on a frequent basis. Since the flight schedule continues throughout the year, there will be increased probability for having both man controlled events and naturally occurring environmental threats occurring in close approximation of time. The shift of USAF and NASA ELV payloads to flight on the STS increases the probability for the man controlled events being on KSC.

The increasing participation of the DOD in the EMSS operation and the question of the availability of medical augmentation from the local civilian medical community makes it imperative that NASA and DOD develop a fully integrated and coordinated EMSS/Disaster Plan to serve both centers. The activation of the EMSS for each mission offers an excellent opportunity to regularly test the medical portion of the disaster plan. Periodically other portions of the disaster plan should be exercised to ensure a cohesive preparedness of the medical and other portions of the plan.

An assessment of the current status of the medical disaster planning for the two centers was made. It was learned that the medical portion of the KSC plan remains in a "draft" state awaiting incorporation into the overall KSC disaster plan manual. The KSC overall disaster plan proposes to draw heavily upon the Brevard County Civil Defense Program and the local medical community in the event an emergency were to occur. The medical component of the disaster plan for CCAFS has recently been reviewed by the USAF and was determined to be obsolete, reflected the period when primary USAF launch activity was still at Cape Canaveral, does not recognize DOD interests in STS flight, and does not reflect the current status of on-site medical emergency care through the single BOC for KSC and CCAFS. The CCAFS plan is in the process of revision.

A discussion with a local regional hospital administrator and the emergency medical department of that facility developed the following points: a) They have great concern about the adequacy of

the command, control and communications capability of the Brevard County Civil Defense Program based upon the results of test demonstrations of the inadequacy of the present system each time it has been exercised. They are not aware of any actions taken or future plans that will correct this problem. They were not aware of any plans to exercise the overall system to further define or correct the deficiencies observed in the past. b) The local medical preparedness to perform triage and provide emergency care for a multiple casualty event proved grossly inadequate when confronted with the casualties resulting from the collapse of the condominium under construction in Cocoa Beach in 1981. Although there have been many discussions on how to correct this problem following this event, no definitive plans to correct the situation have been drawn up or tested.

These faults are of a major nature and do require the attention of the management at KSC and CCAFS. Initially, it is imperative that the two centers conduct a hard evaluation of the capability and limitations of the local Civil Defense program to meet emergencies at KSC and CCAFS and to define what can and cannot be depended upon in the event a disaster was to occur. One gets the feeling that rather than drawing upon the local Civil Defense for assistance, the local area may be counting on drawing help to meet their needs from the KSC and CCAFS if a natural disaster was to occur. If the assessment confirms the inadequacy of the Brevard County Civil Defense capability, the centers will need at a minimum, to initiate efforts to handle problems within centers with their own resources.

In the medical aspects, the centers do need to generate a plan to handle the initial triage and emergency care on-site until definitive arrangements for the care of each casualty can be arranged within the local or extended medical facilities. If the local facilities, including the hospital at Patrick Air Force Base, are to be included in the initial care of the casualties, these arrangements need to be negotiated, and the process exercised sufficiently and periodically to ensure a readiness of the system to meet a real emergency. Since the frequency of flight will require a peak readiness of the EMSS/disaster plan for a period of ten to fifteen days each month (prelaunch, launch, preparedness for emergency landing, and end of mission landing), it is further recommended that those aspects of the disaster plan that will occur within the KSC and CCAFS could be handled best through the use of in-house (i.e., government and BOC contractor) personnel. This would avoid disrupting the normal activities of the community medical facilities and their staffs during a major portion of each month. The facilities could be advised of the flight operation but would not need to make any formal commitment of resources until called upon when an emergency situation occurred.

5.3.1 Conclusion And Recommendations

- A. Complete the revision of the EMSS and the medical aspects of the KSC/CCAFS disaster plans as an integrated and fully coordinated effort. Plan for the provision of on-site medical triage, initial emergency medical care and transport of the casualties to

the next level of medical care from resources within the KSC/CCAFS. Plan to use local medical facilities, including the Patrick Air Force Base hospital, for the next level of care. Provide professional staff and provision to handle casualties while on the centers. Communication capabilities are critical in the support of the on-site medical activities and to alert the local medical facilities of the proposed plan for moving casualties to their facilities and to advise them when the patients are ready for such a move.

- B. Establish a formal program of training and field exercises to practice the medical aspects of the EMSS/disaster plan. Set as goals a demonstration of readiness to meet a reasonable emergency scenario. Periodically exercise the medical components with the other elements of the overall disaster plan to demonstrate the adequacy and preparedness of the plan, the interface between elements of the plan and the training of personnel who must execute the plan.

5.4 Aerospace Medicine And Occupational Medicine Program

Discussions in other parts of this section have addressed the potential impact of the space shuttle operational era upon those components directly supporting the medical flight operations. This discussion will address the other parts of the biomedical program, the Aerospace Medicine Program, and the Occupational Medicine Program. As the flight activity intensifies at KSC there will be an

increasing demand for medical support from these programs. The increased demand will be felt primarily between the launches and can be viewed as additions to the current overall daily baseline activity.

The work load required to meet the accelerated launch schedule can be expected to result in a major increase in the stress levels of the government and contractor work force unless there is an associated increase in the numbers of the work force. Without an increase in work force size medical planning should anticipate growth in the number of visits by workers to the KSC and local community medical facilities due to the increased stress in the work environment. Therefore, the impact of the flight schedule should result in increased demand upon medical resources within and outside KSC. A more detailed discussion of the Aerospace and Occupational Medicine and Environmental Health Programs follows.

5.4.1 Aerospace Medicine Program

During the earliest flights of the space shuttle the numbers of crew members were limited to two/flight and the amount of time spent by these crews at KSC during flight preparation was quite short. During the flight preparation period, any medical problems of the crew member were easily handled through direct contact with the medical staff of the Biomedical Office and the Occupational Medicine and Environmental Health contractor.

Beginning with STS-5 and thereafter the number of crew members per flight has increased to an average of four and will become higher with NASA's program of offering to fly more payload specialists and/or guest passengers. Since the primary thrust of each mission has changed from the testing of the flight vehicle to one of flying the payload, prudent medical planning would expect that the amount of time spent by the flight crew at KSC will increase especially for those involved in the payload operation during the critical phases of payload buildup, checkout, integration, and introduction into the orbiter vehicle. This will be in addition to the usual amount of time that has been spent previously during critical events during the preparation for launch.

The increasing frequency of flights, and the related decrease in time between launches, will result in several payloads being in various stages of preparation at one time at KSC. Therefore, it is not unreasonable, for planning purposes, to expect the payload and mission specialists for several flights to be at KSC at any one time. If NASA continues to house all of the flight crew members at JSC, this would result in a major increase in the number of the transient flight population at KSC at any one time and their stays would be for longer periods of time. As a reasonable planning scenario it is proposed that the payload specialists, and perhaps mission specialists, will spend the major portion of the ninety days prior to flight at KSC.

The level of medical examination and the Health Stabilization Program have been reduced in a major way beginning with STS-5 to reflect the length and type of mission now on the manifest. This change appropriately reflected the NASA spaceflight experience and good preventive medicine practices in disease control. However, the aerospace medicine and preventive medicine programs will have to return to the more extensive medical examinations and a higher level of the Health Stabilization Program when mission lengths are extended sufficiently to allow incubation periods for illnesses to become important again. In the future when a new crew would be proposed to join an already orbiting group of people in a space station the quarantine and limited access to the crew preparing for flight could be an essential part of the preflight program. In either case a fully outfitted medical facility, including supporting laboratories at KSC, will be important for use in controlling disease in the primary crew and in preventing the transmittal of diseases to flight crews already in orbit.

To gain some insight into the magnitude of the future needs for aerospace medicine care at KSC a simple analysis was conducted that assumed that the current mission manifest and schedule were met. It also assumed that crew size was as listed in the manifest (JSC 13000-7) and that payload and mission specialists would be at KSC most of the increased period of ninety days prior to flight during payload buildup, integration and checkout. A summary of this analysis is included in Table 2. It does not include any time at KSC for the mission commander or the pilot, does not reflect the

recent trend to increasing the mission duration, makes no allowance for the associated increased work load at KSC that may result from additional late experiments and does not reflect the recent trend to add payload specialists to conduct the added work.

In the future, if the mission and payload crew members were to be moved to KSC to better use their time, the population requiring aerospace medical care would rise to the size of this population. Also, not reflected in this analysis is the potential for the addition of non-NASA payload specialists to flights, an opportunity that was opened by a NASA statement of policy in November, 1982. This analysis only offers some insight as to what the minimum size of the aerospace medicine program at KSC might be. It does not address who will provide the care.

Table 2. PROJECTED NUMBER OF MISSION PAYLOAD SPECIALISTS
AT KSC PER MONTH*

	<u>1983</u>	<u>1984</u>	1985	<u>1986</u>	<u>1987</u>
JAN	2	4	0	5	0
FEB	2	4	0	5	6
MAR	2	4	0	5	10
APR	2	2	6	5	10
MAY	0	4	6	3	9
JUN	4	2	4	3	7
JUL	4	6	2	0	7
AUG	4	8	6	2	4
SEP	4	10	9	5	End current
OCT	0	6	9	5	flight
NOV	2	4	9	3	manifest
DEC	2	0	2	0	plan

*ASSUMPTION - Mission and payload specialists will be primarily at
KSC for ninety days before launch.

- Current flight manifest as of July, 1982.

To date JSC Medical Operations has provided the flight surgeons needed to support all of the launch and landing operations. In most cases the JSC flight surgeons have also covered important flight preparation events as well. The aerospace medicine staff of KSC has supplemented the JSC effort on an "as needed" basis. In most cases this has been one of conducting physical examinations of primary contacts at KSC as part of the Health Stabilization Program, providing medical augmentation to the Emergency Medical Support Systems and occasionally providing backup for the JSC physicians

during any checkout events. As the flight frequency increases and landings begin to occur at KSC the amount of time and number of JSC flight surgeons that would be needed at KSC at any one time to cover the flight preparation and the actual flight events will challenge the ability of JSC to provide the coverage. Flight assignments for JSC flight surgeons will begin to overlap.

The basic issue can be simply stated: Can or would JSC want to continue to provide the amount of support that has been previously given for each flight during all phases of the payload preparation, prelaunch, launch, landing, and postlanding periods? Since multiple missions will be in varying stages of this cycle at one time, it would seem reasonable to assume, for planning purposes, that an increasing amount of the aerospace medical support would be sought from the KSC staff. This assumption also would include the transfer of other support functions now accomplished by a number of JSC professional staff traveling to KSC for each mission.

The alternatives to shifting these activities to the KSC staff are ones of JSC augmenting its staff sufficiently to enable it to handle the increasing work load or for JSC to establish and permanently staff an Aerospace Medicine Office at KSC. Both of these alternatives bring with them a rather large cost for those involved. The approach to increase the number of JSC flight surgeon staff will bring with it the associated increased cost of salaries and travel for them and a growing unrest that does occur within a professional staff following prolonged and frequent periods of travel. There

also will be problems of maintaining professional currency and development if the flight schedule is met. The approach to develop a cadre on assignment to KSC brings problems of assuring staff promotion, recognition and personnel morale. This latter approach was used during the Apollo program. The experience demonstrated that all of the problems suggested here are not theoretical but did occur. The problems of both of these approaches speak against them as viable alternatives. The obvious approach would be to assign as much of the routine operations as possible to the KSC Biomedical Office staff. The staff of the Biomedical Office would need to be built to meet the task. JSC would maintain oversight of crew care and health maintenance planning.

It is recommended that KSC undertake discussions with JSC with the goal of defining the roles of the two centers. KSC should prepare itself to anticipate a transition from the present mode of having all flight and routine aerospace medical care provided by JSC. Issues that need detailed clarification include: a) The definition of the functions to be assumed by the KSC Biomedical Office; b) The number of crew members that can be expected at KSC at any one time; c) The amount of time crew members will be at KSC during the mission preparation and the schedule for effecting the transition. Parallel discussions to identify the role of the KSC Biomedical Office for the DOD flights should be conducted with the DOD. After these discussions there will need to be a detailed planning effort within KSC to define and schedule the activities of the staff of the Biomedical Office, the existing OMEHS, the EMSS and aerospace medicine program.

In addition, it must be recognized that the transfer of portions of the NASA crew aerospace medicine program to KSC brings with it a requirement to collect and transmit data on the medical findings, treatment provided, and outcome of the illness of the crew to the JSC longitudinal data collection program. This will necessitate close coordination and the development of a detailed data format for capturing this information. Most of the data collected on astronauts to date has been done at JSC, including the laboratory work. Future planning will continue to have them receive their annual medical examination at JSC. Therefore, it is important that KSC ensure that any medical data or information collected on crew members during the year be done in a manner that is compatible with the JSC medical data collection and management system.

The discussion above has made certain assumptions as regards the crew members remaining in the JSC area. The validity of this assumption should be obtained from JSC Flight Operations. If the decision is made that there will be more KSC activity by the crew members, including KSC area becoming their home, it could heavily influence the amount and direction that the medical support functions should take.

There is a precedence that NASA could draw upon for making this decision. The military services have been confronted with similar problems of deciding whether to deploy on temporary duty or transfer the entire force to a new operating base. The military services have used all approaches. However, as cost and maintaining

personnel satisfaction have become increasingly important, there has been a tendency to draw upon the resources of the local receiving base to the maximum feasible as a way of reducing the numbers of people displaced and the cost for such a deployment. In the case of the aerospace medicine program for such units, the flight surgeon may or may not deploy depending upon what the mission is and what is available for medical support at the host base. In the case where the flight surgeon travels with his unit, he remains committed to the mission of his unit but is integrated for medical support into the medical operations of the host base and he draws from the medical resources on the host base to the maximum possible.

5.4.1.1 Conclusions And Recommendations:

- A. Undertake discussions with the JSC to establish the KSC short-termed and long-termed role in providing aerospace medical support for the crew members in payload and orbiter preparation, prelaunch, launch, landing, and postlanding periods.
- B. Establish numbers, frequency and duration of crew visitation to KSC.
- C. Initiate discussions at all levels in NASA that will lead to decisions as to whether astronaut crews will continue to be domiciled at JSC or will ultimately be assigned to KSC.

D. Use the data in A-C above to design and develop the KSC aerospace medicine program, facilities, occupational medicine flight support, and staff planning for the shuttle program.

5.4.2 Occupational Medicine And Environmental Health Program

KSC has progressively implemented the program detailed in the NASA Management Instruction (NMI) 1800.1C, NASA Occupational Medicine Program. The recent opening of the exercise facility initiated the last major element of a full program as prescribed in this NMI. The program includes: a) occupational medicine support (i.e., work related physical evaluation, the diagnosis, treatment and referral for work related illnesses and injuries, medical support of flight operations, invited visitor medical care); b) preventive medicine support (i.e., periodic physical examinations to detect early stages of medical problems, mental and psychological health support, establishment of toxic and hazardous exposure standards, exercise and physical conditioning guidance, immunizations); c) environmental health support (i.e., health physics, environmental engineering, hygiene and sanitation standards and measurements); d) non-work related provision of medical treatments (i.e., provision of treatments, prescribed by private physicians, while on the job as a means of reducing the loss of time from work).

The current program represents a well balanced effort and reflects a good recognition of the local work place environment and the urgency of maintaining the work force on the job and performing at a high

level of efficiency. As one projects to the future, especially when viewing the work load to be expected with the acceleration of the STS flight program, maintenance of this full program becomes increasingly important. As the KSC matures as Spaceport (East) it will shift its mission support efforts toward the follow-on STS program or a space station. All of the medical requirements now included in today's program will continue to be needed and the work load should be expected to increase due to a larger demand for preparing payloads and materials for transport to space. Therefore, it is reasonable for planning purposes to expect the demands upon the OMEHS program to increase. One question remains: Are there alternate approaches for organizing and managing the program that would better serve the future of KSC? The discussion that follows addresses this question.

The medical care aspects of the current program have been long standing and have been well accepted by both the federal and contractor employees. The program of assisting employees at KSC to receive treatment at the KSC clinics, as a cooperative effort between the employee's physician and the OMEHS contractor, has done an excellent job of compensating for the long distances between the local care providers and the work site. These efforts have proven beneficial to all parties, the patient by reducing the time lost from work, the employee's physician by increasing the probability that the prescribed therapy will be obtained on time and under medical supervision, and the employer by minimizing the amount of time off the job by the employee for obtaining therapy and providing

confidence for the employer that the worker's time away from the job is for medical treatment. Whatever program configuration or management structure that is proposed for the future should ensure that the current medical support efforts and the non-work related provisions for medical treatment are maintained.

It must be recognized that KSC represents a rather unique work environment which requires a comprehensive OMEHS program. Some of the unique features include: a) the flight missions at KSC (STS and ELVs); b) the large size and scattered nature of the activities at KSC and the CCAFS; c) the presence, transport and routine use of large quantities of many of the most exotic, extremely toxic and hazardous chemicals, fluids and materials; d) the presence of a large number of contractors (each with many employees) conducting work in shared facilities; e) the long distances required to reach local medical care facilities outside of KSC and the CCAFS; f) the large number of daily and invited visitors that pass through KSC; g) the expected increased work load that will be required of the work force to meet the future STS flight schedule; h) the KSC OMEHS program serves both the KSC and the CCAFS.

The complexity of the work tasks and the work environment makes a strong case for the continuation of the current centrally managed NASA OMEHS program. Fragmentation of authority and responsibility for the overall effort would present problems of coordination, assurance of timely and integrated resolution of issues and problems, and a special problem for assuring a quality product of the effort.

In spite of this strong support for continuing the present approach, other alternatives were examined. One alternative, the assigning to each contractor and each federal group the responsibility for the conduct of their own occupational medicine effort. In addition to the inherently more costly overhead that would be required for the many groups doing the same basic job, it must be recognized that many facilities and work areas are shared by different contractor and government groups. If each group were made responsible for its own program, different rules and policies could result in a single facility and between facilities. Different standards for work place practices and estimates of hazards could develop. In the event an accident or injury did occur there would be problems of establishing who is responsible for the problem, who must correct the problem that led to the accident, how to resolve differences in levels of disability that could arise in employees of different companies and/or the federal government for a common injury or illness due to the work place. These complex issues could only be resolved through a strong central oversight and management program and the conduct of an equally vigorous quality control program. To be effective, this effort would approach the central management program now in place. The present central management of the effort by the Biomedical Office has clear lines of communication and responsibility. This alternate would have to be adjusted to meet the individual program of each contractor or federal group. Authority and responsibility would be difficult to assign and to enforce. The risk to the KSC or to the employee would be equal to or greater that can occur with the

current approach due to the number of company and federal groups involved. In summary, although this alternative can be made to work, it presents no advantage over the current organization and does present many major additional issues for management if it is to be successfully executed. It offers an excellent opportunity for inequity in care and case management and offers grounds for legal action to be initiated by a disgruntled employee.

Another alternate management approach would be the retention of overall oversight of the effort by KSC center management but reassignment of elements of the current program to other components of the Center management. In the analysis of this alternative it became clear how important it is to be able to directly interchange information; to be able to bring an interdisciplinary team to bear on the analysis of the problem and the selection of its solution; and to be able to draw upon the several professional backgrounds to put the solution into practice. Biomedical and environmental issues often require multi-disciplinary solutions. For example, in the case of a noisy work area that exceeds the standards and limits for personnel exposure, the problem can be addressed through the reduction of the levels of noise (an operational and engineering solution), through the isolation of personnel from the noise source (an operational and engineering solution), through the provision of noise limiting devices for direct use by the employees (a medical, environmental, bioengineering and operational solution) or combinations of the three approaches. Practically, the combination of approaches is most commonly followed. Subsequently, the chosen

solution needs to be tested to demonstrate its adequacy (a medical environmental and bioengineering function). Only through such an integrated analysis and response can the Center management, the employer and the personnel involved be assured that the chosen solution is adequate. In the event there has been an injury or damage to the ears of an employee, the case assessment needs to evaluate the environment and the medical changes in the hearing capability (i.e., a medical, bioengineering and environmental task). The currently combined OMEHS organization has been able to meet effectively the difficult analytical tasks. Separation of these program elements through assignment to other parts of the Center management would present additional requirements for ensuring the quality of the products of the efforts and that there has been full coordination and, where appropriate, integration of the effort into a cohesive answer.

In summary, this alternate approach is also workable but would bring with it additional problems of coordination and management oversight. This alternate offers no advantages over the current program but would present an increased problem for assuring that the product of the effort has been efficiently and completely done.

One must conclude that the current integrated OMEHS program and management represents the best approach for meeting the needs of KSC. Projecting for the future the current approach of central management through the NASA Biomedical Office and the execution of the program through a single OMEHS contractor represents the course of choice.

The new OMEHS contractor is expected to continue the present program almost as it was inherited. It was noted in the request for proposal that the overall work force at KSC is expected to remain relatively constant over the life of the STS program. On first glance one would expect the medical work load to remain relatively constant as well. However, there are other factors that may effect a change from this expectation. Compression of time for the turn around of the orbiter, and to process the payloads for each flight would lead one to expect that the work force would need to increase to meet this accelerated tempo of flight operations.

There has also been some expression that with the older work force retiring over the next few years there will be a reduction in the number of those with chronic illnesses seeking assistance from the OMEHS. Again, there are some offsetting elements that warrant consideration. Of special note for the OMEHS program is that the flight tempo of one flight per month, beginning in late 1983 and beyond, is proposed to be met using the same size work force that is presently servicing a once per quarter flight schedule. The accelerated flight schedule will be met by the use of three, or possibly four, orbiters that will require ground recycling, and the processing of the associated payloads for each flight. This will require precision production lines. The addition of the landing and postlanding activities at KSC, as new ventures, also increases the overall work load. It can be expected that all of these activities will be driven by schedule and constrained to limit costs. For a constant work force to accomplish these increasing goals, major

improvements in productivity, efficiency and cost controls will be required. At the same time precision, reliability and accuracy will remain as standards of work accomplishment. Much of this will be achievable through improved processing methods and improved experience levels in the work force. The remainder will have to be accomplished by an increase in work throughput. This load will be borne by the work force.

Examination of the flight schedule through 1986 shows that this increased tempo will continue throughout this period. In addition, there is already a developing trend toward the addition to the mission duration and the mission payload activities for each flight. Therefore, the already heavy schedule appears to be one that will progressively become more intensive. Work loads on each mission will be changing, and generally increasing, right up to launch. The work environment for the work force will become increasingly stressful during the shuttle flight program.

The scientific literature indicates that improved productivity can be accomplished for short periods of time through motivation of the workers and their understanding of the importance of their jobs. However, in the case of the shuttle program these work demands become constant, continue over years, and show no relief until mid-1986 or later. As a result, this high tempo of activities will become the standard for work accomplishment expected. It will result in a high stress level work environment. The literature addressing this type of environment, and the experience of NASA during its

early manned spaceflight programs, indicates that the initial improved level of productivity will be followed by a lowering of work efficiency, errors will be made that will cause additional stress upon the worker committing the errors and a resulting drop-off in productivity.

Associated with the work problems will be an increasing incidence of personnel and health problems. These will take the form of medical complaints, absenteeism, family stresses and the resulting additional medical complaints, job turnover, and a general attitude change that is reflected as a loss of interest in the work. All of these can have a heavy impact upon the expected success in the work place.

The OMEHS program and the work place management must be alert to this potential problem and coordinate their efforts to ensure that early symptoms of the stressful environment and trends are detected and acted upon before they become serious problems for the flight operation. The patient experience (i.e., numbers, diagnosis, place of work) in the OMEHS program can provide one of the earliest indicators of future trouble. Decisions about increasing the work force to provide some relief for individual work levels may be needed. In the meantime the OMEHS program must provide the needed support to the workers who are having trouble. The level of support must be sufficient to prevent an impact upon the schedule and the successful conduct of the mission related work.

5.4.2.1 Conclusions And Recommendations:

- A. The current centralized NASA management with a single OMEHS contractor for the conduct of the program represents the best approach for providing this service to KSC and CCAFS at this time and for the foreseeable future. The concentration of all of the elements of the current program should be maintained within a single management of the Biomedical Office since decisions and actions taken depend heavily upon the interchange of data and interaction between the several medical, environmental and bioengineering elements represented in the staff of the Biomedical Office.
- B. Familiarize NASA management with the potential problem of the stressful work environment that can occur in meeting the present flight schedule with the same work force. Obtain early senior KSC management understanding of the impact that this can have and what courses may be followed to minimize the effects upon the mission schedule.
- C. Prepare the occupational medical staff and program to be alert to the symptoms and signs of stress occurring in the work force. Transmittal of the findings to the management structure at the earliest date is essential to avoid the problem getting out of hand.

D. Discuss and work with local medical community to obtain their input and support in the early detection of this as a problem and in the support of the worker and his family during the period of symptoms and signs.

5.5 Medical Care For Invited Visitors For Shuttle Operations

As discussed in Section 4.0, the present plan for inviting visitors to the shuttle launch and landing events will continue at present levels until after the STS-9 (Space Laboratory 1) mission. At that time a decision will be made on further continuation of the present plans or the modification (including the shift of a major portion of the handling of visitor effort to the KSC VIC contractor). The primary determinant for the direction the program will take will be the degree of continuing interest in attending the flight events, i.e., the continued inquiry seeking invitations and the percentage accepting and attending launch and landing events. A related assessment of the continuing interest of the press will be used in the future planning for attendance by the press. If interest of the VIP and press wanes, the VIP and press sites will be merged, an action that could ease the demand upon the medical resources.

In a similar manner, the number of car passes for viewing the events at KSC will be continued at current levels unless interest wanes or operational exigencies dictate the need for a reduction in the number as a means of easing the congestion on the roads during the pre- and post-launch and after landing periods. The KSC PAO is

open to discussion of the current program at any time beginning with the operational era if the support of each mission would recommend reducing the crowd size.

The impact that this offer to reduce the crowds could have upon the medical support program becomes clear when an analysis is made of the incidence, medical problems, and sources of those who have sought medical care, including all categories of visitors, during the prelaunch periods to date. The source of those seeking care have been the VIP guest site, the press site and the two causeway sites, with the majority being from the causeway sites. The predominant complaints were insect bites and upset stomachs. A total of 40,000 to 60,000 visitors and press have attended each launch at KSC through STS-5. The number who have sought medical aid have ranged between six and fifteen people per launch (0.015% to 0.04%). Of those seeking assistance, four were recommended to return home and seek further medical care for their problem, and one was moved by helicopter to the local hospital. Helicopter transportation was used in this case because of traffic congestion at KSC rather than the severity of the medical problem.

The medical support provided for the care of the invited visitors for STS-5 was ten medical vehicles, six physicians, eleven nurses, three para-medics, eleven medical corpsmen, two drivers, one laboratory technician and one clerical person. These resources were assigned to sites other than the VIP, Press and Launch Control Center (LCC). The number of the visitors seeking medical assistance

was five out of the potential population of 40,000 to 60,000. This represents only 0.01% to 0.008%. None of the five complaints were judged serious and no follow-up care was recommended. The STS-5 and 6 level of request for care is almost identical to that sought during the prelaunch periods for STS-3 and STS-4.

If one were to assume that physicians are paid at \$30/hour, nurses at \$10/hour, and all other personnel at \$9/hour, the medical vehicles average cost is \$30/hour, and the launch period is for eight hours when the visitor areas were covered, the cost for this stand-by service is approximately \$6,000. These rates should be considered conservative since the time is based upon regular duty time. Many launches have been conducted requiring overtime, holiday time or weekend time accounting. This manpower and vehicle commitment for STS-5 includes the costs of three military physicians, four nurses, two drivers, and six medical corpsmen who covered the two NASA causeways and the USAF viewing sites. Using the cost/hour factors above this represents about \$1,650 of the overall \$6,000 that was paid by DOD.

Of equal importance, these resources, once they are on-site at the visitors viewing areas, are not easily made available for "call-up" if they were to be needed for an emergency at the pad, LCC, or the SLF due to the crowding on the highways.

With the initiation of landings at KSC, the additional cost of providing medical support for the formal and the overflow visitor

viewing areas will be needed. Providing equivalent levels of care to that provided for a launch would call for the placement of at least two medical vehicles, staffed by two physicians, two nurses, two para-medics and two corpsmen. If one assumes the time on site to be four hours, the cost for this effort would be approximately \$700 per landing. The cost for supporting visitors' care for each launch and landing would then be \$5,060 for NASA costs alone and \$6,700 for the NASA and DOD costs. These costs exclude the medical costs for coverage for the VIP, press and LCC sites. Considering that in 1984 and beyond STS flight frequency will average one per month this results in costs of \$60,720/year for NASA alone and \$80,400/year if one considers both NASA and DOD costs, sums that warrant scrutiny in view of the low utilization rate for visitor care.

Road congestion has been of primary concern on the causeways entering KSC, between KSC and CCAFS, and in the overall area around the VIP and press sites, and the LCC. In addition to the VIP, press sites and LCC area being heavily populated during a launch event, they are also near the launch pads. On the basis of the random distribution of the direction of the winds that might be present during the launches, they could be in the path of the fallout from the postlaunch cloud or fallout resulting from an early abort of the mission. Therefore, there is a potential for medical problems occurring at this site from either natural or a shuttle related circumstance. The congestion at the VIP, press sites, and LCC could also slow the medical response to a problem in the area. A

perceived delay in handling a medical problem that arises from this area could present difficulties for NASA PAO.

To date, medical planning has concentrated major amounts of medical resources near the LCC. This placement has made them convenient for the address of any problems arising at the LCC. They are also conveniently placed for further deployment in the event of a major accident in the pad area. However, the occurrence of a launch area accident could present a special problem for NASA. The road congestion in this area and the visitor confusion that could be expected in the event of an accident may further limit the mobilization of these resources for movement to the accident site and could also impede the transport of casualties to care. Deployment of the medical resources to the accident scene near the launch pad would leave the VIP and press sites with only minimal medical support in the event that chemical fallout from the burning of the solid or other booster products would drop upon the VIP and press site area. One alternative to having the VIP and press exposed in the event of an abort would be the development of a plan to return these people to their buses or under cover as soon as possible after the emergency occurs.

It is expected that a similar cycle of interest to attend the end of mission landing at KSC will occur. When the flight schedule intensifies there will be at least two days per month when traffic congestion will present a serious problem for the ground movement of patients to medical care on or outside of the KSC. PAO has assumed

that the initial high level of interest in viewing the landing will be followed by a drop-off in interest. At the time the reduced level of interest occurs, it is proposed that attendance to the landing could be turned over to the KSC VIC contractor and the control of these visitors will be handled in concert with present plans for touring visitors.

The readjustment of the visitor medical support effort will become increasingly important when the frequency of launches and landings increases at KSC. The number of medical personnel that will be needed to meet direct support for the launch and landing activities will require an increasing portion of the available resources on a continuing basis. The best source of obtaining the added resources is through a draw-down of resource commitment from the visitor sites.

5.5.1 Conclusions and Recommendations:

- A. Initiate plan to limit visitor attendance and/or to maintain clear roadways, as a means of reducing the amount of traffic congestion on the roadways used by automobiles coming into and going out of KSC and CCAFS during launch and landing periods. A reduction in numbers attending should reduce the number of requests for medical assistance arising from the visitor group.
- B. Configure NASA visitor programs in a manner that will make ground transportation of any cases requiring transport practical. As

the numbers of visitors are reduced and sites consolidated or closed, select the site to remain open on the basis of keeping the road system open and available.

C. Provide only "first-aid" or emergency care for visitors. Configure medical support system to reflect this level of care. Expect the family or friends to transport the individual in the event further care is needed. Plan for additional KSC resources, beyond first-aid, being called upon only in case of an emergency as determined by the medically trained person at the scene. Maintain medical staff and equipment at OMEHS facility at Medical Command Center or the Bioastronautics Operations Support Unit (BOSU) until they are dispatched on the basis of need.

5.6 Life Sciences Payload Support Program At KSC (Experiments)

An important operational function of the Biomedical Office at KSC is the provision of the ground base support of the research investigators while they are at KSC. The spectrum of experiments to be supported is quite broad. It is expected that they will include: plants, animals, lower forms of the biological hierarchy, man, biotechnology and human engineering.

The Biomedical Office does not provide the flight hardware for the experiments or the integration and checkout of the hardware in the payload. However, it does provide the ground based holding and preparation facilities for biological specimens that will be included in the payload.

There are two facilities being prepared to support this function, the LSSF in Hangar L on the CCAFS, and the BDCF in the Operations & Checkout Building (O & C) at KSC. The LSSF is prepared to support all experiments that use non-human material for testing. The BDCF is proposed to provide capabilities for the support of human experiments.

5.6.1 Non-Human Experiment Support

The KSC Biomedical Office has not sponsored a flight experiment or had a role in the selection, definition and preparation of experiments to be flown aboard the STS vehicle. On the other hand it has been assigned some unique roles for the support of all such efforts when they move to KSC to begin payload integration. These include the provision of administrative and laboratory space for the research investigators and their staffs, housing of the test species prior to their incorporation into the payload, support services to assist the investigators in their preparation of their experiments prior to flight, any portion of the ground based control studies for the experiment that the investigators want to conduct at KSC during flight, and the KSC support of the NASA sponsored student experiments.

The LSSF (Hangar L), a dedicated facility for use in the support of non-human experiments, is nearing completion and will be fully operational by mid-1983. This facility is the product of the joint efforts of the KSC Biomedical Office, Cargo Operations Office, and

ARC Life Sciences Division. These groups recognized that a generic facility would be required during the shuttle program that would be capable of supporting the research investigators who will be conducting animal, plant and other biological species studies on the STS. In the planning of the LSSF it also was anticipated that the investigators may seek to conduct ground based control experiments, in parallel with the flight experiments. The facility design included this capability.

Although the facility will not be fully operational until mid-1983, it has already begun its flight experiment support phase. Ground laboratory support was provided for the Continuous Flow Electrophoresis Experiment prior to STS-4 and STS-6. This is an experiment to test a prototype concept and hardware for the manufacture of purified biologicals. It represents an early entry of commercial enterprise into space manufacturing. Support of the preparation of student experiments began in the summer of 1982.

An examination of the inherent capacity, flexibility in design, and growth potential, leads one to conclude that the LSSF should be able to handle all foreseeable non-human payloads. This conclusion was reached after testing its capabilities against early lists of requirements for Space Laboratory 3 and 4. Confidence in the capability of the LSSF was confirmed. Preliminary discussions to identify the support requirements for Space Laboratory D-1 also have not identified any problems of providing the support for the non-human biological experiments for this payload.

Present schedules and life sciences payload planning to date indicates that a large portion of LSSF will be required for the support of a dedicated non-human life sciences payload only for short periods just prior to and immediately postflight during the 1980s. This rate of utilization should allow ample space and time for the accommodation of additional carry-on or mid-deck experiments that can use these unique laboratories during the interim periods.

The NASA requirements for using the facility to support carry-on or mid-deck experiments have not developed at this time. This approach to conducting flight research should be expected to grow in a major degree since it offers the most opportunities for getting a single experiment into the flight program and offers the quickest route for moving an experiment from concept to obtaining the flight results. Each lead NASA center has stated that it intends to look into identifying additional experiments to be conducted as mid-deck or carry-on items during the next year. KSC should anticipate these new requirements for support will be coming soon after the planning is completed. Looking at the capacity of the LSSF indicated that even with a moderate increase in the request for support of future individual flight experiments there should be adequate capacity in the LSSF to accommodate them fully.

The animal holding facility was also examined from the view of whether it will meet the standards for care of research animals. This examination drew heavily upon the experience of ARC in seeking certification of their animal facilities by the American

Accreditation Association for Laboratory Animal Care (AAALAC). Previous personal experience gained while obtaining and retaining AAALAC certification of a major research animal facility at an industrial research laboratory and in DOD research laboratories was also used in the examination. From this examination it was concluded that the LSSF, when completed, should meet all of the current standards for housing animals and should be fully certifiable by AAALAC.

AAALAC, during the certification process, will examine the qualification of personnel managing the facility and those providing direct care of the animals, the adequacy of the operating procedures being followed and the documentation program and the records being kept on all actions involving procurement, feeding, treatment, assignment to study and disposition of the animals. Present plans propose to adopt as many of the procedures, documentation methods and the record system being used at the ARC program as are practical. Additional procedures and documentation programs are being added as needed. It is recommended that NASA staff the LSSF with qualified in-house animal care personnel and obtain the outside veterinarian support that will be needed to meet the personnel standards for certification. Having a fully certified and staffed animal facility at KSC could simplify operations at KSC for visiting investigators, and minimize the number of their personnel who would have to travel to KSC for the mission.

Certification of the facility would reduce the potential impact of any action taken by the antivivisectionists if they were to single out the use of animals in space research for special public attention. The use of animals in research is coming under increasing scrutiny and challenge. Some of the most persuasive arguments that have been made by the several animal protection groups are: a) the experiments using animals are poorly planned; b) alternate approaches that would require no animals can be used to achieve the same objectives; c) the actual use of the animals during the conduct of the work is poorly controlled; d) laboratory animals are generally inhumanely treated. The claims are general in nature but regularly produce an emotional response from the public and the press. The claim of such abuse is usually accompanied by a specific example of abuse, preferably citing a local situation to accompany the claim. Even though these claims are proven to be false or grossly overstated, the damage has been done since the program is put on the defensive and must prove that the accusation is not true.

The best defense against such accusations is to establish practices that will prevent such a claim being justified and for KSC to be prepared to demonstrate publicly as soon as a charge of abuse has been levied that it is false. The most successful counter-action once the charge has been levied is to invite the accusers and the press to visit the animal operation and to show that the management and operational practices would preclude abuse of animals in their routine care and during their use in research.

Since the LSSF and its operation will be capable of certification, obtaining the certification for the facility is a most desirable and recommended objective.

There is also adequate unassigned space within Hangar L for future growth of the LSSF if and when it might be needed. The basic facility is sufficiently flexible in design to permit the accommodation of the various work loads between the time when the need for expansion is determined and the addition is in place. Scheduling of space use becomes the critical element of management for this. Therefore, the tasks associated with LSSF are ones of completing the facility, the scheduling of the work into the facility in a manner that will efficiently use this capability and maintenance of its readiness for future payload experimenters.

There is also a continuing requirement to upgrade the generic equipment and the data management system in the LSSF facility to keep pace with the STS program, the payloads and the improvement in biomedical technology. Data storage, analysis and transmittal compatibility should receive special attention since principal investigators will be coming to the facility from around the world and activities conducted at the facility will need to interface with the Payload Operation Control Center (POCC) and the investigator's home laboratory.

5.6.1.1 Conclusions And Recommendations:

- A. The LSSF, including its capacity and design flexibility, is adequate to meet the presently projected requirements for non-human experiments through Space Laboratory 4 and preliminary planning for Space Laboratory D-1. Sufficient additional space exists within the Hangar L for future growth that may be expected during the shuttle program.
- B. The current facility design is sufficiently flexible to enable it to accommodate a wide variety of experiments yet to be identified. The flexibility and the trend toward providing a generic facility for use by the life sciences investigators should be continued. Long-termed dedication of an area to one technical research objective or goal should be weighed carefully before a commitment is made to tie up the laboratory area for an indefinite period. Guidelines that might be used in the decision include: the importance of the work, the importance of the work to the answer of NASA issues, the time required to finish a meaningful piece of the work.
- C. Planning for the utilization of the LSSF facility should begin now to ensure maximum but efficient utilization of the facility. Priority in planning should be given to protect the availability of the technical facilities to accommodate flight related experiments.

D. Proceed with certification of the animal facility by the AAALAC.

This certification will provide for NASA and any outside interested groups tangible evidence of the quality of the facility and its operation and, strong leverage to encourage the utilization of the facility by NASA and outside agencies when their experiments come to KSC for flight. It will also be a strong incentive for use in recruiting professional staff to come to KSC to work.

E. Establish a program to maintain and upgrade scientific equipment and the data management, analysis and transmittal capabilities at LSSF to ensure that it keeps pace with the experimenters, the shuttle program and the advancing state of the art.

5.6.2 Human Experiment Support

In contrast to a maturing readiness of the support facilities for the non-human life sciences experiments that can now be envisioned, the parallel preparation of facilities to support human experiments is still in its earliest state. Specifically, the only firm requirements for the support of human experiments that have been developed to date are those for the support of the experiments on Space Laboratory 1. As a result the BDCF now in construction has been designed to meet the needs of Space Laboratory 1. The laboratory space being allocated for Space Laboratory 1 is being made available from both dedicated and general experiment support space in the O & C Building. As a result the conduct of the

preflight work will be a scattered operation and will result in less than ideal or efficient use of the crew member's or experimenter's time as they prepare for this flight. Some of the general laboratory space will be returned to the pool for investigator support after Space Laboratory 1 has been flown. It will need to be reestablished again as subsequent flights are in preparation.

The development of a general detailed requirement document for the facilities and resources that will be needed for the support of the future human experiments program has eluded completion. For example, the definition of the requirements upon KSC for Space Laboratory 1 has been quite difficult to pin down and stabilize. A preliminary requirement for a generic human experiment support area indicated a need for 11,000 square feet of laboratory space. However, this number has become lost. JSC has since shifted only to looking at the Space Laboratory 1 needs. This requirement has settled on approximately 5,500 square feet of space. Requiring this degree of variability for each dedicated mission will prove quite a problem for KSC.

Planning for Space Laboratory 1 has developed no requirements for the use of the preflight data collection hardware at KSC to be operated as ground control experiments or trouble shooting efforts during the mission, nor have there been any plans identified for having the principal investigator teams at KSC during the mission so they could address inflight issues. Both of these areas should be given some attention in the planning for future flights.

Experiments with problems arising during the mission could be resolved through analysis and troubleshooting efforts that used the same hardware and techniques for these efforts that were used during preflight data collection and are planned for use later during postflight testing. Such efforts would require direct data links and voice communications with the Mission Control Center (MCC) and the POCC at JSC.

The new operational approach for conducting space research related by Headquarters NASA, Director of Life Sciences, calls for more of the actual experimental work to be performed in flight rather than on the ground. Such a change will increase the chance of needing to address problems while the experiment is underway. Therefore, planning for future life sciences missions should consider the use of the human experiment facility in the support of the future dedicated life sciences payloads that are scheduled to be flown once per year or year and one half.

In the same vein, planning at KSC should anticipate an increase in the number of mid-deck or carry-on experiments as the means of answering or defining operational issues that occur between the dedicated missions. These experiments would require the availability of a KSC human experiment support facility on a continuing basis. The dedicated life sciences missions, especially those with multi-national sponsorship and investigators, using the Space Laboratory 1 as a model, will require extensive "hands-on" opportunity for working out details of the experimental protocol and

procedures. The carry-on and mid-deck payloads will be integrated into the orbiter and will receive their first checkout prior to launch at KSC. The period of integration and checkout that has been required for Space Laboratory 1 is approximately one and one half years. Even though subsequent life sciences payloads and experiments should better this first experience, it is still expected that such activities will require up to six months for a dedicated payload and perhaps longer for the foreseeable future. Carry-on or mid-deck experiments should not require periods of time approaching that required for a dedicated payload. However, as this approach becomes more popular, time and space in the human research facility will have to be allocated to permit their preparation for flight. This period also will serve as a key period of time for the working out of the final details between the investigator and the mission payload and/or specialists.

The NASA program for flying student experiments will place a special demand upon the KSC human experiment support facilities. In the Hangar L facility students are already availing themselves of this facility as the site for preparing their non-human experiments. A parallel opportunity for using such facilities for experiments on the crews has not been available and has been treated on an ad hoc basis. These experiments are being planned on many flights and could be closely akin to the carry-on or mid-deck experiment needs discussed above.

Judicious planning would call for the development of a general, flexible, dedicated life sciences complex for the support of a full range of human research that can be expected for future missions. This general facility would serve as the life sciences area for conducting the ground base aspects for all dedicated payloads and carry-on and mid-deck experiments that will be conducted in orbit in the shuttle and later in a space station.

Since the experimental testing will use flight members as the test population, it also is suggested that the life sciences research complex for human testing be placed conveniently adjacent to the crew offices and medical operations facilities. This would minimize the travel time, the disruption of the crew and the medical and research team as they complete their preflight test work. Often the body fluid and microbiological samples taken during the preflight period are time critical for processing if a comparison of the results pre-, during, and post-flight is to be made. Placing the medical operations facilities close to the experiment support facility will permit the sharing of common laboratory capabilities (i.e., hematology, blood and urine processing, etc.) and thereby gain a better return on the investment for these facilities and minimize the need to duplicate the capability.

To gain maximum efficiency and returns on the investment for the human experiment support facility, serious consideration also should be given to locating it adjacent to the in-house research laboratories. Collocation would permit the use of common clinical

laboratories, examining and testing facilities on a continuous basis. This would minimize the amount of dedicated life sciences space required and minimize the number of laboratory personnel required to service all functions, the flight experiments program, the in-house research program and a readiness to provide aerospace medicine or flight medical operations support whenever needed. It would also provide a better balance between capability and KSC generated throughput for the clinical hematology, chemistry and microbiology laboratories. Optimization of the throughput will facilitate the maintenance of the laboratory certification being obtained from the College of American Pathologists. Collocation of all of the life sciences facilities would provide a flexible multi-disciplinary capability at KSC that would be able to adjust to the needs of the flight program as they arise or to the changing thrusts of the shuttle program as it further matures.

The paucity of hard requirements on what is expected at KSC by the human research investigators presents a special problem for the Biomedical Office. It offers a large potential for being judged as less than responsive when late requirements are received and can either not be met or met only at great cost. For example the Hangar L facility required from the early discussions in 1978 to the second quarter of 1983 for its successful completion. The parallel planning effort to identify the requirements for a human research experiments support facility was initiated in the 1978-1979 period but has not been successfully completed to date. During this study definitive guidance had been sought. However, planning for support

of human experiments and for this facility have remained on a mission by mission basis. This leaves the KSC Biomedical Office in an awkward position of being expected to be responsive to the lead center's and experimenter's needs but unable to get a definition of the long-term requirements.

To offset this dilemma an analysis has been conducted to arrive at a generalized facility model for the support of human experiments that can be used in the future discussions with the NASA centers proposing to conduct human experiments. The model was drawn up using the present requirements for Space Laboratory 1, the experience gained from previous NASA human research experiments and informal discussions with those participating in Space Laboratory 1, the experience gained during the development of the Hangar L facility, initial planning for Space Laboratory 3 and 4, and, during the evolution of the in-house research program. This model for the human experiments support has been folded into a similar analysis of the requirements to support shuttle medical operations and the future in-house research program. This overall model is discussed in Section 7.

5.6.2.1 Conclusions And Recommendations:

- A. Develop a definitive requirements document for the facilities and equipment required for the support of the human experiments program for the STS program. This is an urgent item for discussion between JSC and KSC. The product of this effort,

should be further refined in turn for the purpose of obtaining the best efficiency in the overall biomedical efforts at KSC. The analysis should address such issues as cost savings, increased efficiency and flexibility to be gained by collocation of the experiments support facility with those for medical operations and the intramural research program. The objectives of the study should be to gain the best return from the investment for the facilities through the maximum use of the facilities on a continuous basis while remaining fully prepared to support the flight medical operations and life sciences experiments as they are required.

- B. Pursue a similar dialogue between DOD and KSC to identify the experiments support needs of DOD that may be levied upon KSC. Ensure that KSC planning will be able to accommodate DOD needs as well as other NASA centers. In this discussion the methods that the DOD proposes to use in its medical operations and in the support of its research investigators should be defined since the DOD characteristically depends upon the facility where the work is to be done to provide more support than the traditional NASA center concept. Assuming that there may be a desire to make changes in overall NASA management of experiments during the shuttle operational period, the DOD conversation may serve as a guide for the NASA centers to work out an efficient process for the future execution of its experimental program.

C. Accept the concept that KSC will be an operational spaceport.

The medical and life sciences efforts should move toward gaining the maximum efficiency of the use of the facilities, resources, and, especially, personnel, in the provision of support for all who will be using the facilities at KSC during the shuttle operations. KSC should pursue a course to define, design and put into place those facilities, resources and capabilities to ensure readiness to support the investigators who will fly human research experiments on the space shuttle.

D. KSC should use as a goal, the provision of a set of generalized and flexible facilities that can adjust to the unique or special needs for any future flight while at the same time being able to support assigned routine activities that are transferred to KSC. These facilities should be designed to meet the general need of life sciences for the future as KSC matures as a spaceport and as the STS program matures to longer missions or the support of a space station.

5.6.3 Interface Between The Crew And The Life Sciences Non-Human Flight Experiments

The planning of dedicated life sciences payloads will bring with it the issue of the crew-test specimen interface and interaction prior to and during the mission. The scientific literature reports on the potential problems of cross-reaction and cross-contamination of man from his exposure to animals and vice versa. The clinical

literature also presents many examples of a similar reaction between man and other life forms (i.e., allergy, sensitivity to plants and animals). Such a transfer in either direction during the preparation and the flight of a life sciences payload could affect the results of the experiments or the mission or both. NASA guidelines for use in the preparation and conduct of experiments inflight that require living test specimens need to be developed.

On NASA sponsored flights to date all living test material has been flown on unmanned vehicles; were isolated in a self-contained life supporting unit that limited their exposure to or from the crew; used a species and such small numbers of test specimens to minimize the risk to the crew or to the test specimens. The planning for the dedicated life sciences payloads, however, will involve direct association of the scientist and/or the payload specialist with a variety of plant and animal species since several experiments can be carried on the same flight. Planning for and understanding these direct interfaces and interaction will require NASA and principal investigator attention. The guidelines to govern these interactions in space flight still must be developed since the scientific literature reports on this topic primarily from a ground based laboratory prospective and is generally limited to discussions of the interaction between man and animals. In the shuttle mission the exposure will be in a vehicle with a totally synthetic atmosphere and in a completely new ambient environment for the test specimens and the crew. A new look at the procedures during preflight conditioning and postflight recovery may need to be done to ensure a satisfactory preparation for this cross exposure.

The flight interface will begin and end at KSC after the landings start at KSC. Therefore, the KSC Biomedical Office will need to be involved in the process of developing the plant and animal/crew guidelines, especially for those aspects involving the pre- and post-flight activities.

The Director of Space and Life Sciences at JSC has expressed the intent of initiating the development of the guidelines for the crew-test animal interface as a cooperative effort with the ARC. The initial call for the effort needs to be broadened to include other life sciences test material interfaces. These centers do reflect the logical lead NASA centers for the effort. In the preliminary correspondence for developing the guidelines, the KSC role and its importance were not clearly understood. The importance of the time at KSC in the pre- and post-flight activities must be emphasized to the lead centers. The inclusion of KSC in the effort to develop these guidelines should be urgently pursued.

The scientific literature extensively discusses the potential for the transfer of disease between man and animals. A few examples of known pathogens have been cited in the literature in actual experiences where such a transfer occurred. Proper screening of the crew and test animals for pathogens prior to contact should eliminate needless exposure and risk to the mission. Therefore, caution should be taken in making too much of this issue for spaceflight. It is recommended that the guideline development effort be constrained and the limitations imposed held to the

minimum required to control disease transfer since needless constraints could influence the experimental results, operational procedures or the ability to conduct certain experiments.

Another, and perhaps more important factor that should be considered is a need for the guidelines to recognize and reflect the importance of the psychological and behavioral interaction of the crew and the test animals, especially non-human primates, during the preflight and flight periods. These interactions, especially in the primate species, could influence the course of stabilization of the animals as they are being prepared for the flight. The guidelines should address the establishment of sufficient familiarity by the animals with the investigator or the payload specialists and the research methods to be used to minimize or define any effect that could cause a change in the flight results.

The issues related to animal-man interactions, noted above, are most complex and have a potential for gaining criticism for NASA if not positively and intelligently addressed. While NASA has had much experience in flight medical operations, it is not long in experience in the area of animal and plant flight operations. There also is limited experience in NASA concerning issues related to the man-animal interaction except those encountered in the operation of the conventional vivarium. Therefore, it is recommended that NASA call together an expert panel of advisors in the fields of Zoonosis, animal behavioral conditioning, plant-man sensitization and allergy, to work with the staff of the NASA centers in the development of

overall NASA guidelines for protecting the test materials, the crew, the flight results and the agency.

5.6.3.1 Conclusions And Recommendations:

A. NASA should develop agency guidelines for the exposure and interaction of the crew-life sciences test specimens during the prelaunch, orbital and postlanding phases of a mission that will carry life sciences experiments. The guidelines should consider the issues associated with the transfer from man to the test specimens and from the test material effects to man occurring in a partial recycling synthetic environmental control system. In addition, guidelines addressing the conditioning and behavioral impacts that may affect the animal specimens readiness for the flight and the results of the experiments should also be developed. Provide adequate consideration of this issue but avoid overkill that would negatively affect the flight operation, cause certain experiments to be dropped or produce additional problems for the mission. Guidelines should also consider the cleanup of the spacecraft after return from flight to reduce the chance for cross contamination between the test specimens and crews on subsequent flights.

B. Include in the guideline, development process all of the NASA centers that will be impacted by the issue, the lead centers, JSC, ARC, and the KSC because of the important aspects of the pre- and post-flight activities that will be conducted at KSC.

C. Establish expert advisors in the fields of Zoonosis, behavioral conditioning and familiarization of animals to test conductors, and test material-man sensitization and allergy to provide expert support to the NASA effort to develop guidelines.

Another important function of the KSC Biomedical Office is the conduct of an intramural life sciences research program. Although this effort has been conducted to date as a separate endeavor from the support of flight operations, the issues that have been studied have a direct impact upon the ability of KSC to support the missions. Therefore, this program which has gradually grown in scope, complexity and diversity of issues being addressed, needs to be considered in the overall context of what its future should be, what resources may be required, how it will be conducted, and how it will fit with the direct medical operations and flight experiment support for STS and later missions such as a space station. This section of the report discusses the options available, their importance to NASA and KSC, their relationship to the other activities of the Biomedical Office and provides recommendations on what options are available to KSC in pursuing a future intramural life sciences research program at KSC.

Previously, the KSC Biomedical Office primarily provided the local occupational medical support for the KSC NASA staff and supporting contractors, as defined in the NASA Management Instructions, and the medical support of flight programs as requested by the lead NASA center for each project. The latter area was accomplished by having the NASA lead center levy a detailed set of requirements upon the KSC Biomedical Office and, KSC in turn responded to the request in the amount and on a schedule needed to meet the project schedule.

When the flight events were scheduled, representatives of the lead center traveled to KSC and conducted the events, then returned to their home center for the completion of the data analysis and preparation of the reports. The KSC role could be summarized as one of responding through the provision of support to meet requirements levied by outside requesters. All technical, scientific, operational, and major project management decisions were retained by the lead NASA center for the project. It is within this historical background and context that the initial research efforts at KSC began.

Initial research studies were directed toward the address of specific KSC occupational and environmental issues that could influence the ability of the worker at KSC to perform his job, the medical care needed for the local worker population, or to answer an issue related to the support of a proposed flight operation.

Early efforts were limited by the expertise and the personal interests of the professional staff of the Biomedical Office. Studies were characteristically short-termed, of limited scientific or technical scope, and were directed toward obtaining the answer to a specific, but often limited, question. The span of the research efforts were fairly limited to the study of worker physical stress in the work place or in special work conditions such as operating in Self-Contained Atmospheric Protective Ensemble (SCAPE) suits. The scope of the research and the in-house laboratory capabilities have evolved from this austere and narrow beginning to the current

research efforts that are now addressing increasingly complex issues. The discussion that follows analyzes the future options and opportunities which the research program at KSC can follow.

6.1 The Life Sciences Research Climate At KSC In 1982

The initial research thrusts addressed local stress and physiological costs for the KSC worker. Priority for study were those jobs that imposed physical and environmental stress upon the worker. More recently, studies have been added that also seek to understand the environmental and ecosystems at KSC and the effects upon these that the STS operations may produce. In some respect this work can be considered an extension to the previous effort. It provides further understanding of the work place stresses and what will be required to provide a safe work place for the employees at KSC. The technical expertise represented in the staff, the laboratory capabilities, and the number of professional staff conducting the research efforts have grown to match these broadened research objectives.

NASA Headquarters, Office of Life Sciences, advised the Biomedical Office in 1982 that KSC should broaden its research horizon to include research on issues of more general interest to NASA, including those of flight related issues. This suggestion brings the KSC Biomedical Office research program to a major crossroad. It can continue on its present course and at its present level and scope of focusing upon KSC issues or it can be developed further, as

suggested by NASA Headquarters, and become involved in the broader spectrum of research of general interest to NASA. In the latter case it would still be expected to continue the study of local area concerns as well as the more general interest issues. The discussion that follows addresses this decision. The course to be chosen is assumed to rest upon what will be best for science, NASA and KSC.

6.2 Future Course Of Life Sciences Research At KSC

Research programs to be successful must have five basic elements; adequate research facilities, time to conduct the research, an adequate scientific staff, funding, and research ideas that warrant the research investment. Each of these will be discussed as they apply to the situation.

6.2.1 The Research Facilities

The decision on the future course of the research program at KSC can be influenced by other actions already underway at KSC. For example the completion of the LSSF facility (Hangar L) and its commitment to the support of non-human life sciences experimentation for flight aboard the space shuttle has provided an outstanding set of research facilities, one of the high initial costs for starting or enlarging a research program. The investment in this facility has been approximately \$2.0 million. The annual budget to maintain this facility in a state of readiness to support the investigators,

student investigators, and the in-residence professional staff is estimated to be \$0.5 million. This level of overhead will be needed continuously even though dedicated life sciences missions will be at least eighteen months apart because the facility will be needed to support carry-on and mid-deck experiments that will fly on STS missions between the dedicated missions. Therefore, the LSSF must remain active and staffed between dedicated missions to maintain the laboratory facility in a state of technical preparedness, to meet the developing experiment program and to retain its laboratory certification by the AAALAC.

This leads one to ask whether there is a way NASA can gain a better return from the approximately \$2.0 million capital investment and the \$0.5 million annual operating costs while still meeting its flight operations support requests. The answer is that it can be accomplished by keeping the facility operating at capacity. When flight experiments are at KSC, they receive the preferential support for the investigators for flight experiments. At other times the in-house research program could fully occupy the available time and space. The change in overall costs for LSSF operations to accomplish this full work load would be the addition of the research funds that have been approved for the support of the specific studies. This should result in the costs per man-year of research effort conducted in the LSSF being less than the approximately \$50-60 thousand per professional man-year that is used by government contractors since a portion of the overhead will have been contained in the \$0.5 million for operating the LSSF. As a result, a man-year

of research at KSC should be obtainable by NASA life sciences at a rate that could not be matched outside of the government, and probably by other government laboratories. All that has been stated here in regard to the LSSF will be equally applicable to the BDCF for human experiments when it is completed.

In the near future there will be a certification of the clinical chemistry, hematology, and microbiology laboratories by the College of American Pathologists and the vivarium by the AAALAC. Included in the certification process in both cases will be the approval of the staff who will operate the facilities, their scientific qualifications, the policies, the documentation system, and the administrative practices. To maintain this approval, these factors must be maintained in a state that will be judged upon reinspection to be an acceptable level. The KSC facilities offer to NASA its second set of certified life sciences capabilities for the conduct of human and non-human animal research in-house at one center. The availability of adequate research facilities in which to work satisfies the first of the key criteria for the establishment of a quality research institution.

6.2.2 Time Availability To Conduct The Research

The life sciences dedicated missions are proposed to be flown every eighteen months or more. These missions would be expected to require the intensive use of the LSSF and BDCF during some period before, during, and immediately after the flight. For planning

purposes it is estimated that the time needed before each mission will be at least three months, and probably not exceed six months. The guidelines for the design of the LSSF and the BDCF called for sufficient size and flexibility to permit the accommodation of a sufficient number of investigators to meet a dedicated mission that would emphasize either non-human or human experiments. One might expect that each flight will be a mixture of experiments and therefore would require only a portion of each facility. As a result, there should be space and time available for continuing an intramural ground based research program at some level even during these peak periods. In the event that a given dedicated payload did require the full capacity of one or both facilities, proper planning should be able to ease the impact on the in-house ongoing research.

In the period between dedicated mission activities, there will be some requirement to process and support carry-on, mid-deck and student experiments for the interceding flights. The lead NASA centers for life sciences have not had an opportunity to develop a program to exploit these flight opportunities to date. Therefore, the numbers and frequency of such experiments are still to be developed. This is an important area warranting early NASA life sciences planning since it does offer the quickest opportunity for answering an operational question and a cheaper approach for conducting an individual experiment. In discussions with the DOD it was learned that the USAF does plan to use the mid-deck and carry-on approach for the address of research on man's adaptation, availability for work, to define areas and tasks that can be

assigned to man effectively, and to study the man-machine interfaces. Their first proposed experiments are being prepared for STS-10 and they expect to use frequent opportunities thereafter. In the event the time intervals between the life sciences dedicated missions were to be extended, the carry-on or mid-deck approach could become the most attractive approach for flying experiments to both the NASA life scientists and the DOD. An ambitious program of NASA and DOD carry-on and mid-deck experiments could be accommodated easily in the LSSF and BDCF due to the size and flexibility of the facilities and through good scheduling. There still should be ample time and space for the conduct of KSC intramural work.

Estimates of the cost of a dedicated life sciences mission range from \$250 to \$300 million from announcement of opportunity to final report of the experiments. Cost per mission of this magnitude causes the NASA life sciences staff to doubt whether more frequent dedicated missions could be justified beyond those now projected for eighteen month intervals. The only exception would be the encounter of a major operational issue that could threaten the continuation of the STS flight operations. The likelihood of such an event occurring in a short STS mission is small in view of the experience now available.

Of equal importance, it is the expressed opinion of the life science staff at the ARC, the lead NASA center for non-human research, that the additional experiment development programs to meet more frequent dedicated missions could not be accomplished without a fairly large

addition to their staff, regardless of whether the additional work was conducted in the academic community or by the NASA in-house professional staff. Under the current fiscal climate, in their judgement, there is little likelihood of major additions to the staff of the NASA research centers that would permit the program to be enlarged sufficiently to allow more frequent dedicated missions than presently scheduled. Therefore, one must conclude that the eighteen month frequency for the dedicated mission will be the maximum frequency for such missions. As a result there should be ample time between dedicated missions to accomplish both carry-on and mid-deck experiment support and a KSC initiated research program within the facilities.

6.2.3 The Research Staff

The Biomedical Office has developed an in-house capability in selected areas of expertise; the cardiovascular-respiratory systems, stress physiology, a developing expertise in exercise physiology, musculo-skeletal metabolism, environmental physics, and plant physiology and ecology.

The projection that there will be time and laboratory space available in the KSC research facilities, even during the peak periods of dedicated life sciences missions, offers an excellent opportunity for NASA to broaden its scientific base by extending invitations to additional investigators to use the KSC facilities for the conduct of research being sponsored or of special interest

to NASA. NASA could invite investigators who are experts in an area of special NASA interest at the time (i.e., vestibular, musculoskeletal, hematology, ecology) to spend their sabbatical periods in the KSC laboratories. While at KSC conducting research of mutual interest to NASA and themselves they could share, guide, and act as a catalyst for enhancing the in-house programs in related areas. This would offer the opportunity for obtaining additional expertise for limited periods for the NASA life sciences program at a minimum cost since most academic programs will provide partial support, up to one-half of the normal salary and benefits, for a staff member on sabbatical leave.

The presence of such expertise at KSC would also serve as an excellent scientific interface with other research investigators as they come to KSC to prepare their experiments for flight. This could provide a special plus for NASA when the non-United States investigators are at KSC and are preparing to conduct their first experiments in the United States. The continued building of an excellent research staff in residence and the augmentation of this staff through the addition of recognized experts in fields of interest to NASA could provide the third leg of a research program, a strong professional staff.

NASA's ability to obtain and retain a quality professional staff to operate this facility will hinge, in a large way, upon the degree of opportunity that the resident staff members will have to further their own research and career development goals during periods when

the flight support operations are not demanding their full attention. The combination of research opportunities, exposure to experts in their field, and the principal investigators for flight experiments should provide an excellent environment in which to work.

6.2.4 The Research Ideas And Opportunities

The fourth leg of a research program is the development of good research ideas or opportunities. The identification of immediate research opportunities at KSC is already occurring. New prospects that further address local KSC issues are being proposed at a rate faster than the present staff can complete the work on them. Recently, the previous brief, short-ranged studies of local occupational and environmental hazards and stresses are being replaced with longer-termed research protocols to compare complex changes in female crew members with that seen in the male astronauts to date. In addition, a long-ranged study program of the environmental impact of STS operations at KSC has been prepared and is now in the approval cycle.

Another research protocol to identify, quantify, understand and control the condition of the musculo-skeletal system has been submitted for approval. The ultimate goal of this work will be the development of a physical conditioning program that can be used in orbit by crew members for maintaining the integrity and condition of their musculo-skeletal system in a state of readiness for their

return to earth gravity. There is no lack of pertinent research ideas and the list of candidate areas for investigation is growing.

The effort to develop new research ideas should be viewed as a continuing one. The conduct of a research study often results in new questions or the better definition of an old question. Often the completion of one research effort serves as a catalyst for the generation of a family of new efforts.

There has been an expression of concern that no new ideas in life sciences have been suggested in the past decade. It has been noted that every new call for research ideas results in a restatement of the same old areas being recommended for study. While this appears to be true on the surface, NASA would be well advised to recognize that it has not conducted an organized and structured research program to answer most of the research issues that have been suggested during the last decades. In the main, pre- and post-flight studies have been emphasized. In flight only periodic sampling has been accomplished, usually with variable lengths of time between sampling events. In most cases the data have supported making gross conclusions on overall crew status. In many cases basic physiological process and mechanisms involved have not been identified or tested. Trends and rates of changes have not been established. Interrelationships between body systems as the whole body adapts to the space environment have not been clearly defined.

Observations taken during flight have served generally as bridge data to be used in interpreting the ground developed data base. In many instances the flight data have been judged successful if they showed that there was a relationship between the ground laboratory data and real flight event (i.e., lower body negative pressure testing predicted generally that seen in flight aboard Skylab; fluid and calcium shifts observed in flight followed the same general direction as that observed during the use of bed rest and water immersion simulation of "0" gravity on earth). In other cases the flight results showed only the lack of correlation (i.e., the lack of effectiveness of either flight acrobatics or laboratory testing to predict who will become ill with "space sickness"; the lack of bed rest studies to predict the red cell mass loss seen in flights). The USSR has now become the repository for the best and most complete life sciences data base on man's adaptation and operation in prolonged manned spaceflight. Their program has been methodical and continuously conducted. This matter was brought into focus during a recent USAF briefing to industry where they stated that they have concluded that an extensive scientific program on man, his adaptation, his performance capability, and his role in the future space and mission operations is needed before they would be able to support a recommendation to place man for a prolonged stay in orbit that would heavily involve him in the operation of vehicle and payloads.

There has now been a philosophical change within NASA which calls for the conduct of more of the research effort to be performed in

orbit. This offers a new opportunity to study the dynamics of a phenomena in the body systems and to collect data to be used to identify trends of changes or adaptation. System to system interaction can now be addressed as well. This will allow the life scientist to move beyond the point where he can only state that the adaptive changes do or do not affect flight operations for missions of the space shuttle duration. While this served as an excellent initial conclusion for moving man into space, this should not be construed to mean that the interest of the life sciences community in understanding these physiological processes has been satisfied.

It is important that those planning for future life sciences research to establish some overall general longer-termed life sciences goals upon which to build their program in a way that it will serve the NASA goal of extending man's presence in space. To this end it is recommended that a general goal be established to develop a data base in the biology, physiology, and behavioral areas that will be needed to conduct extended duration manned missions (i.e., thirty days and beyond in weightless flight, or if gravity is required how much and when it will be required). For the evolution of biotechnology it is recommended that a similar goal be established that will lead to equipment, systems, provisions and procedures that will be applicable for similar longer periods aboard a space station. A third goal, and somewhat the opposite of the two above, should be the development of life sciences data and biotechnology development that will enhance or facilitate a high level of efficient performance of the crew members when they are in

the launch phase or soon after reaching orbital flight. If the Biomedical Office were to decide to follow the course of further commitment to broaden its research effort, it is not too early to begin devoting some of the staff and contractor effort toward developing additional research protocols that would address the overall goals noted above.

Naturally, the longer-termed efforts of research must be integrated with the ongoing work that is addressing local KSC issues. Providing solutions to these local tasks will continue to be important and will need priority consideration because they address the immediate concerns of the KSC Center Director and center management. KSC management should expect responsible and timely action on concerns of primary interest to them.

A future broader research program, on the other hand, will further increase the capability of the research facilities and the staff and will develop an increased ability to answer future more complex issues of concern to the KSC management. Such research will provide a better insight into the influence that the KSC environment has upon the overall flight results and operations. The broader ranged research program and the program that addresses local issues should be viewed as complementary and be developed to reflect this philosophy.

6.2.4.1 Candidate Areas For Research

The discussion of the candidate areas for research that follows will be divided into those within life sciences and those within biotechnology. These areas all meet the long termed goals of data collection that will serve decision making for space station, provide data for the KSC management, or provide advances in technology for future NASA programs. For this discussion those related to the study of environmental changes and impact have been included under life sciences.

6.2.4.2 Life Sciences Areas Of Research

Candidate areas of general NASA interest include: a) the comparison of physiological and physical data obtained from the full spectrum of potential human and non-human flight candidate biological species; b) the development of a more complete data set to establish "normal and variation of normal" in the spectrum of human candidates for space flights; c) the effects that the KSC environment may exert upon the research results obtained during flight; d) the detailed definition, the trends and the interaction of changes that occur in the adaptive process during space flight; e) especially examine the process, trends, and system interactions during adaptation in the cardiovascular, respiratory, renal, musculo-skeletal, endocrine, neurological, and immunology systems; f) the understanding of fluid-electrolyte balance, metabolic balance and nutrition in the space environment; g) further clarification of

whether the human will need some amount of artificial "g" for a prolonged mission, if artificial "g" is required, how much and for what periods of time; h) the understanding of the effects of medication and its effectiveness in treating the illness for which it is given, wound and bone healing and the effectiveness of other modes of therapy while in the space environment; i) the formal study to identify the important behavioral, social, and elements of habitability to improve living and understand working performance and efficiencies during extended spaceflight; j) the effects of changes in the work-rest cycle while in orbit; k) the effects and significance to the crew of the electromagnetic and special energy (i.e., radiation frequency, laser, nuclear) milieu aboard a spacecraft in a prolonged mission; l) further definition of the natural radiation environment, its risks to the crew for missions beyond the inner Van Allen belts and the effectiveness of protection of the crew from these effects; m) development of criteria for use in defining survivability for the crew; n) the overall performance of the reproduction, growth and development on a broad spectrum of living tissues and organisms; o) an organized program to evolve a data base on the effects of reduced gravity from "0-g" up to "1-g"; p) research to further define the unique and special geography and climate and the local biota and ecological spectrum at KSC; q) research to further define the natural and man produced changes in the KSC ecological systems; r) microbiological studies to establish the clean up procedures and control of microorganisms in the spacecraft, the payloads and future space stations.

As an example of a research effort to attack an immediate operational issue, NASA has singled out the investigation of "space sickness" for major attention. The advice of the experts indicates that this is probably a complex problem or series of problems and that it will require extensive study in ground laboratories and during flight to understand the phenomena. The USAF has questioned whether it is really only a vestibular system event. The overall program may take years and if previous studies of this area are indicative, may prove unsuccessful. Of equal importance is the need to understand the degree of disability that may occur and its potential for the performance of the mission. If there is a sufficient degree of disability that mission performance could be affected, there must be a parallel effort initiated to develop the means for controlling or eliminating the symptoms.

KSC has already initiated the first long-ranged studies of the local center environment. This research has been driven by pertinent questions that have been raised about the impact that the STS operation will have on the local environment. However, KSC does represent a unique natural and operational environment. It does present a most unusual geography and a special biota and ecology, all factors that should stimulate outstanding environmental and ecological research programs. It is recommended that the complexity of this challenge warrants KSC undertaking a separate long-ranged planning effort to define the research programs that can use the special opportunities at KSC. It is also recommended that NASA KSC obtain the services of recognized experts in the several disciplines

that would be expected to perform in this program in order that the planning effort will represent a good technical plan with an acceptable return on the effort.

6.2.4.3 Biotechnology Areas Of Development

Parallel challenges can be identified in the biotechnology area. In some cases these efforts may be interrelated to ongoing biological research areas already underway at KSC. As an example, there will be a need for an intensive effort of research and, where appropriate, technology development to meet the ultimate goal of providing a fully controlled ecological system for use on the long duration space station. This system would be based upon the concept of recycling waste products and environmental products, and would have as its goal the approach toward energy balance aboard the vehicle. This program should be viewed as an evolutionary one that will occur over several years.

KSC is developing an excellent base of research knowledge and experience to undertake development of the data base that could be used in the design of biological environmental system elements. For example, it is a natural extension of the ongoing work to improve the yield of hydrogen generation through the biological oxidation of waste materials. This program has been initiated to address a local need at KSC and could serve as the means for extending the KSC technical capability for solving longer-termed NASA issues. It is the type of program that should be encouraged if KSC elects to follow the broader research road.

It is suggested that segments of the equipment of a controlled environmental system will be incorporated progressively into the station as each element is brought to sufficient maturity to warrant its safe and efficient application into the flight operations of the space station. Centers other than KSC will be pursuing physical, mechanical, and electrical approaches to the recycling of the waste and the operation of the environmental systems. Many of these developments will require ground based and flight experiment testing. KSC has such ground test facilities and perhaps could augment the other centers in the test program. In any case KSC can serve a valuable role in assisting the other centers as they prepare their flight experiments for flight on the STS. Some feel that the ultimate systems should have total recycling of waste materials. Biological recycling of at least a portion of the waste products offers a viable long-termed solution for segments of the system.

Since any KSC biotechnology effort would be an initial venture for this Center, it might be prudent to make its early efforts in concert with other NASA centers with longer experience in these endeavors. Two centers that have been key in such effort are the ARC and JPL. Both have pursued ventures in the early development of biological controlled ecological systems in the past. The current levels of effort in this area are at a sustaining level. With a renewed interest in the development of a manned space station within NASA, these centers can be expected to accelerate their efforts. If KSC desires to participate in these efforts, the combination of the KSC effort with those related efforts at the other centers would

strengthen the overall NASA program and the KSC research and technology program.

Additional biotechnology areas that may warrant KSC attention include: a) Physiological monitoring - examining new techniques, preferably non-invasive, for data collection on the health, function and well-being of workers at KSC in high stress work area (i.e., workers using SCAPE suits, firemen and workers that must climb on the gantry structures). The methods developed here would have the potential for future application in prolonged spaceflight, especially for use in monitoring personnel who are working remotely in an extra vehicular mode or in a self-contained pod.; b) Environmental monitoring - the development of new methods and new application of other new technology for more accurate and reliable monitoring of the environment, especially new methods that will better measure the levels of highly hazardous materials, fluids and aerosols that are used at KSC. As noted under physiological monitoring, the establishment of these new methods, as reliable for measuring the ambient KSC environment, could provide a technology data base for use by the space station design engineer in selecting his environmental monitoring systems. This effort could build upon the extensive experience that is accumulating on environmental monitoring at KSC.; c) Data management methodology - an endeavor to further evaluate and develop the collection, management and analysis of medical data. This effort could examine a range of options including the use of immediate data collection and analysis (i.e., computer assisted diagnosis), following of trends in an acute

illness or exposure through the use of an electronic medical records system and longitudinal analysis of the medical records of long-termed employees for determining occupational liability due to a hazardous work environment. These options encompass the previous effort by the KSC Biomedical Office staff in computer aided diagnosis (CAD) and the proposed computerized Occupational Medicine and Environmental Health and Safety program now proposed for initial test at KSC by NASA Headquarters.; d) Test bed testing - the application of the altitude, heat simulators, and laboratories in the LSSF, BDCF, and the Intramural Research Facility at KSC to functionally test equipment for use in the space station. These facilities could serve a special function by providing the capability for handling integrated life support and experiment tests as the individual elements of hardware are moved toward their integration into the vehicle or the payload.; e) Applications testing - the development of new methods of therapy for space crew members that require new technology or equipment for the method (i.e., the cardiopulmonary resuscitation garment for use in space flight now under development). As additional information is gathered under the several candidate areas within life sciences, new candidate biotechnology opportunities should become clear.

6.2.5 Financing The Research Program

The sources of funds for the research projects to date have been obtained directly from the NASA Headquarters, Life Sciences Research Program through Research Technical Objective Plans (RTOP), the Space

Shuttle Program Office (shuttle vehicle development and cargo programs) and the KSC center Director's discretionary funds. Funding for the operation of the stress laboratory has been granted at a level of funds on a general RTOP. Other proposed research tasks have required an intensive negotiation with other offices within KSC, other sponsoring groups outside of KSC, and often required an approval of the effort and the overall direction of the effort by another NASA center. KSC research proposal requests to NASA Headquarters for life sciences research are coordinated with the lead NASA center for such research. Only the baseline research funding level established for annual support of the stress laboratory operation is committed in a way that will permit for longer ranged planning by the KSC Biomedical Office.

If a decision is made to pursue a broader research program at KSC, a more formal and longer ranged funding program must be sought that will provide a sustaining level of effort over a period of years. This would then permit longer ranged planning to become a realistic goal. Even if the decision is to retain the present research program scope, annual programming would be greatly enhanced if an expected annual target level of funding for each area of effort could be developed.

To be persuasive in obtaining such funding support, the Biomedical Office will require the development of a long-ranged research plan. Planning, in this case, would project what the research goals and objectives of the KSC life sciences will be for a longer period of

time, usually five years. It states where the research activities expect to be at the end of this period and generally lays out a proposed schedule for achieving this long-range goal. It is from this plan that each year's program is then generated. In turn, after each year, the plan is further updated to reflect progress made in meeting the plan, changes that warrant being made based on another years experience, etc. The annual discussions could then be centered upon next year's research goals and expectations and a critique on the results of the past year. If it is judged that there has been a poor use of the sponsor's funds, the discussions should address what should be done to correct the situation and, if not corrected, what reduction in funds or reassignment of the effort might be made by the sponsoring office. Under the umbrella of a reasonable research plan and the demonstration of progress at the annual program review, it would appear reasonable to seek a commitment from the funding sources to provide a certain level of funding per year and the rules under which growth of the funding levels might be considered. Such a commitment would prevail as long as the annual review of how the funds were used is judged to be worth the investment by the sponsoring program.

In the past, funds have been sought wherever they were available. For the single, limited task, this approach was appropriate. However, the program now has become sufficiently mature and has a demonstrated productivity record to warrant changing to the longer termed level of effort approval cycle now enjoyed by other NASA centers.

If the KSC decision is to broaden its base to include more NASA flight issues, it is recommended that a dialogue be initiated with the Space Station Working Group and the Office of Aeronautics and Space Technology at NASA Headquarters, through the Advanced Planning and Technology Office at KSC, to identify the specific areas of interest to them to which the KSC Biomedical Research Program could contribute and to solicit their support through the establishment of research efforts, and hopefully, levels of funding for continuing KSC research on their behalf. The addition of such longer ranged goals in addition to current shuttle mission length objectives would provide an excellent point of reference for solid long-termed planning noted as needed earlier.

Through the multi-pronged approach to gain funding support for the KSC intramural research program it would appear that all five elements of a vigorous research program are attainable. The remaining question is, "Does KSC seek to pursue the broader based program?" It is recommended that KSC undertake the broader approach.

6.3 Conclusions And Recommendations:

A. It is recommended that the KSC Biomedical Office, in full concert with the Director of Life Sciences at NASA Headquarters, establish as its long-range goal an increase in the research activities at KSC to fully use the resources at KSC. It is recommended that KSC research goals be focused upon the

development of the life sciences data base that will be needed to support extended manned orbital flight. This recommendation is made following a detailed examination of: a) the progress that has been made in the current intramural life sciences research program at KSC; b) the completed and developing life sciences facilities at KSC for the support of experiments to be flown on the space shuttle; c) the sustaining costs required to maintain and operate these facilities; d) the availability of these facilities for additional use after fully meeting the requirements of the investigators for experiments to be flown aboard the space shuttle; e) the increasing challenge within NASA to gain the best return on the life sciences research investment; f) the future life sciences data anticipated to be needed to meet prolonged orbital missions. Implementation of this recommendation should be viewed as evolutionary, therefore requiring the development of a long-range research plan followed by annual programming to bring this goal into being.

B. It is recommended that several approaches are appropriate for accomplishing this goal. These include:

1. Initiate a long-range planning effort by the KSC Biomedical Office to identify the areas of expertise and thereby the proposed research and technology thrusts that KSC would seek to pursue in future research and development programs. The planning should include full discussion with the several project and program offices of NASA Headquarters. The

planning should be completed in concert with the other research and technology management offices at KSC.

It is suggested that the discussions at NASA Headquarters include the Office of the Director of Life Sciences, Shuttle Operations Program Office, Space Station Working Group and Office of Aeronautics and Space Technology. The discussion should address additional direct support of new ventures to be conducted at KSC, the possible assignment of other NASA contracted work to be conducted by NASA contractors in the KSC facilities, or the sponsorship of scientific visitation at KSC of eminent scientists to KSC for a sabbatical period. In the latter case the work conducted should be on tasks of interest to NASA. Discussions on funding and sponsorship should seek to gain multi-year support at a negotiated level of funds as long as the work results and progress are satisfactory.

2. Open discussions with other government agencies to identify research efforts that could be accommodated in the KSC facilities that would draw upon the unique geographical, environmental, or ecological aspects of the KSC local area.
3. Identify, as part of the planning effort, other research opportunities that could use the scientific and technical expertise and capabilities at KSC that NASA would not be expected to support. Seek funding for such efforts from other appropriate funding sources, (i.e., National Science

Foundation, Environmental Protection Agency, Occupational Safety and Health Administration, National Institutes of Health, DOD).

4. Initiate discussions and joint planning through the Assistant for Bioastronautics of the Department of Defense Military Support Office to identify medical operations and research requirements to be sought from the KSC Biomedical Office by DOD on military shuttle missions.

5. Establish a life sciences marketing team at KSC to conduct the active search for continuing support for the research opportunities at KSC and/or the utilization of the facilities, but under the KSC operational control.

C. The approaches outlined above should be considered with some constraints and implementation guidelines that will ensure that the STS flight operations and payload development and operations receive timely and full support. These include:

1. Recognize the potential political sensitivity of the other NASA centers to the formalization and the enlargement of the research mission at KSC. This can be seen as direct competition to their missions and funds. It can raise their concern as to whether KSC will be responsive to their needs when they come to KSC for a mission operation. A given in the new research effort at KSC has to be a guarantee that the

concern of the other centers about the KSC resources being available when they need them will not be a problem.

2. The move to pursue a broader based research program will need full support of the KSC Center Director and the senior management staff. The planning should also be fully coordinated with the Advanced Planning and Technology Office at KSC. It is suggested that the timing of their involvement should be before the long-range planning effort has been undertaken. A given for these discussions should be that the local KSC needs will be met first before other elective efforts are conducted.
 3. That the implementation of the long-range plan will be incremental and over a period of transition that will permit the continued demonstration that the issues related to A. and B. above are being met in a satisfactory manner as judged by the other NASA centers and the KSC Center Director.
 4. That DOD commitments and obligations are being met as agreed.
- D. Develop agreements with the sponsoring offices to provide a level of funding for each year that can be expected unless there is a lack of performance demonstrated by the KSC laboratories. The annual program call will deal with an evaluation of how well the research funds have been used during the previous year, the research efforts proposed for the upcoming year, how the research

efforts fit the needs of the overall research plan, and a final revision of the research program to reflect the discussion with the sponsor.

7.0 KSC Life Sciences Facility Requirements For Spaceport (East)

Previous sections have discussed the impact upon the operational support programs and the recommendations for changes and additions to the medical activities and capabilities that can be made as preparation for the STS operational era. The discussions have indicated many choices are available for selection in forming the medical posture of KSC and that the final selection in most cases still remains to be chosen. Even now, changes needed to meet the STS flight schedule with all of their implications for the KSC Biomedical Office are under way. It is not too early for the Biomedical staff to initiate planning efforts, to select what its future goals and posture should be, and to start the process to bring the long-termed configuration for the operational era into being.

The commitment of the STS program to accept the delays in the launch of STS-6 while still maintaining the full flight manifest, and the reduction of the intervals between the next three or four flights as a means of regaining the time lost offers insight into how urgent it is for the medical program that will support this flight program to be defined and implemented. Even though initial changes in medical operations and the activities for the support of experiments are underway, the management mode remains one of reacting to the short-termed needs for each flight. Only through extensive long-ranged planning will the Biomedical Office be able to move from the reaction to a pro-active mode of operation.

The LSSF facility, nearing completion, has the flexibility and growth potential to enable it to meet presently projected needs for supporting a full spectrum of non-human research. The other areas, the aeromedical facilities, intramural research facilities, and human experiment support facilities, do not provide the same assurance of readiness for meeting the future needs as KSC shifts toward becoming Spaceport (East). In the short period of preparing this report, changes in the character, makeup, and scope of the future flights are occurring. The time when the pace of the flights will be accelerated is occurring now rather than the projected schedule that would have started the accelerated flight schedule in less than one year. This leaves little time for a leisurely preparation of plans and facilities for what will be needed during the next several years of STS activity. Further, there is no indication that the now projected accelerated pace of flights will slacken even after the completion of the presently manifested flight schedule.

Just in the past six months there have been increases in the number of crew members/flight, mission lengths have been adjusted for at least one mission and are being discussed for others, the DOD life sciences efforts are becoming more clear and will most probably require the use of the life sciences support facilities at KSC. This report also recommends that the intramural research program be enlarged in degree and scope to better exploit the use and the cost of maintaining the facilities and staff at KSC and thereby gain a better return on the investment.

It is in this vein that it appears appropriate for the Biomedical Office to begin its look to the future with a view of identifying what facilities and capabilities it will need to operate at KSC when it becomes an operating spaceport. These efforts should lead into the formulation of a long-range plan that will define the goals and future projected posture of the Biomedical Office. The plan should stage the work in a manner that will permit it to be accomplished over the next few years. It should define the effort, the resources that will be needed to fulfill the goals, and propose a logical sequence for meeting the needs. These requirements should be described in sufficient detail to permit their rational and timely procurement and/or construction. Planning must recognize the current flight manifest but also must allow for and expect change. The design for change should anticipate that there will be an increasing demand levied upon the support facilities and medical operations. Therefore, facility planning should emphasize design that is flexible and general in nature and will permit the reconfiguration as it is needed.

Preparing for flexibility should expect that mission profiles and complexity will probably change, the makeup and number of crew will be altered (and in most cases increase), the sources of crew members will become more heterogeneous, that the STS may be shifted to missions of a purely transport nature if and when a decision to construct a space station is made. In this latter case planning should expect that there will be a shift in the use of the biomedical facilities toward that of supporting the crews, research

experiments, and life sciences equipment during their preparation for flight to the space station and for their postmission processing after landing. Judicious planning should anticipate that all of the routine day-to-day medical activities will have been transferred to KSC by the time a space station support operation begins.

To provide some insight as to what medical and life sciences capabilities and facilities might be needed, an analysis was undertaken by contractor and NASA Biomedical staff (see Acknowledgements) to identify what facilities will be needed for Spaceport (East) to provide an integrated crew care, biomedical research, and human experiment support capability. For this analysis it was assumed that the LSSF potential would satisfy fully the non-human experiment support and intramural research needs. The analysis used as a point of departure, the previous KSC in-house study reports on crew and life sciences facility requirements, Life Sciences Program Requirements, conducted by Johnson (1980) and the Status Report on KSC/DE/Long-Range "Soft Plan" for Continuing Astronaut and Medical Facilities by Hilton (1981). In the current analysis, the life sciences requirements for the intramural research program were also folded in because it became obvious early that collocation and cross utilization of the facilities offered an excellent opportunity for cost saving and efficiency of use by the crew and the professional staff. Cross utilization also offered the most flexibility for meeting the changing STS mission needs.

Sizing the facilities considered peak loading required to support the dedicated life sciences missions. A list of guidelines was established as a reference during the analysis and are contained in Chart 5.

The raw unedited data sheets that were prepared during the analysis have been included in Appendix A. The information on each sheet reflects the judgements of the preparer. Estimates on space per unit, number of units and special provisions in the units are included in most cases. No attempt to gain efficiency through collocation was made in preparing the basic data sheets.

7.1 Integration Of Human Facility Requirements

As one views these sheets collectively it appears that there are many areas that could be used commonly if the facilities were collocated and cross utilized. As a result of this observation the raw data was then integrated and an analysis to identify the space savings that could accrue was made. The product of this synthesis is presented in Table 3.

The table presents the unabridged raw data requirements, the reduced requirements that could result from integrated planning, collocation and cross utilization of facilities, and the resulting savings in space that would accrue by this move. It can be seen that major savings in space and thereby the costs that would be required to

CHART 5. GUIDELINES FOR THE ANALYSIS OF FUTURE MEDICAL AND LIFE SCIENCES FACILITY NEEDS FOR KSC

- A. Current medical BDCF and research facilities be considered as interim. This study should be directed to identify what is needed and whether the facilities can benefit from integration and collocation.
- B. Mission frequency will be at approximately one flight/month. Minimum interval between flights will 0.5 month and the maximum interval will be 1.5 months. This frequency will be continued for the foreseeable future regardless of whether the STS continues as the primary orbital vehicle or is replaced by a space station for this phase of the mission and the STS assumes a pure transport role.
- C. Crew members, mission and payload specialists, will be spending increasing periods of time at KSC in the three month period before their flight. With the current flight manifest, this will result in at least ten payload crew members being at KSC at any one time that will require aeromedical care. Additional crew members will be at KSC during the critical checkout events. This could add an additional four to six crew members at KSC at these events.
- D. For this study it is assumed that the KSC Biomedical Office will retain direct management of the aeromedical program for the crew care.
- E. Crew size will increase to a total of seven/mission over the life of the STS flight program. This is the size of crew support accommodations that will be required in the medical facility for the pre- and post-flight activities.
- F. Considerations for animal and human laboratory facility design will recognize the need for maintaining separate facilities and instruments where it is appropriate.
- G. Quality control of the laboratory procedures will be maintained for all procedures conducted within the laboratories.
- H. Planning for intramural research programs support should consider the use of combined research protocols that will involve both human and animal analogues of man as part of the study.

CHART 5. (Page 2 of 2)

- I. Visiting research investigators will be offered a series of options for obtaining support for their experiments. These will include the availability of using the certified KSC laboratories and personnel to conduct that portion of his work; have space and services made available in the facilities to permit the investigator to bring and use his own support equipment and personnel.
- J. Data collection, management and possibly analysis will be available for the investigator as the investigator desires.
- K. The LSSF will be adequate to support the basic laboratory needs of non-human research and investigators for flight experiments.
- L. KSC will broaden the intramural research base at KSC to fully utilize the facilities. This research growth will be over a period of years. Overall management and assignment of space for use will be retained by the KSC Biomedical Office.

provide the unneeded and/or redundant space, can be gained. Of equal importance, collocation will provide additional efficiency for the staff as they conduct their work and should keep the number of staff required to accomplish all of the functions at a minimum number. At the same time it also should be adequate to permit the active support of the flight medical operations while maintaining continuous intramural research activities between missions. The improvement in efficiency through collocation is gained in both the technical and administrative areas. Collocation and cross utilization also offers the best way of retaining future flexibility within the facilities as the future requirements to be levied upon Spaceport (East) become more clear.

It should be noted that the summary in Table 3 has retained the option for the individual investigator to bring his/her staff and equipment to KSC if that is desired. This retains the same flexibility for the human research investigator as that included in the design for the LSSF (Hangar L). There is sufficient flexibility to permit the accommodation of visiting scientists to work between dedicated missions. It was also assumed in this integrated approach that the specialized clinical tests originating in the LSSF could use these clinical laboratory facilities where it is appropriate.

This summary has made no allowance for corridors and hallways because the amount of space required for them will be determined in a great part by the design layout. Space has not been included for the administrative offices of the Biomedical Office or the

TABLE 3. SPACE REQUIREMENTS FOR THE SUPPORT OF STS FLIGHT MEDICAL OPERATIONS, HUMAN FLIGHT EXPERIMENTS AND INTRAMURAL RESEARCH PROGRAM

AREA/DISCIPLINE	KSC MEDICAL & RESEARCH PROJECTIONS (ft ²)	LSFE PROJECTION (ft ²)	RAW ₂ TOTAL (ft ²)	CONSOLIDATED REQTS/ PROJECTIONS (ft ²)	SPACE Δ DUE TO CONSOLIDATION (ft ²)
H ₂ O Immersion Lab	12'x20'=240	12'x20'=240	480	240	240
Cardiovascular/Stress Lab	40'x25'=1000	20'x30'=600	1600	1200	400
Environmental Chambers	2(10'x8')=160	-----	160	160	---
Respiratory/Pulmonary Lab	15'x15'=225	12'x15'=180	405	225	180
Shielded Test Areas/BDCF	4(12'15')=720	various=5000	5720	5000	720
Monitored Exercise Area	20'x30'=600	20'x30'=600	1200	600	600
Biochemical Assay					
RIA Lab	15'x20'=300	15'x20'=300	600	300	300
Hematology Lab	15'x30'=450	15'x30'=450	900	450	450
Chemistry Lab	20'x30'=600	15'x20'=300	900	600	300
Immunology Lab	12'x15'=180	12'x15'=180	360	180	180
Blood Processing Lab	15'x20'=300	15'x20'=300	600	300	300
PI General Purpose Labs	-----	3(15'x15')=675	675	675	---
Ground Control Support Labs	-----	3(12'x20')=960	960	960	---
		1(15'x20')=300	300	300	---
Microbiology					
Sterilization Facility	15'x15'=225	12'x15'=180	405	225	180
Clean Room	10'x18'=180	-----	180	180	---
Wash Room	15'x15'=225	12'x15'=180	405	225	180
Enviro. Micro Lab	15'x30'=450	15'x24'=360	810	450	360
Clinical Micro Lab	15'x30'=450	15'x24'=360	810	450	360
Mycology Lab	10'x20'=200	-----	200	200	---
Microscopy Lab	8'x8' = 64	-----	64	64	---
Media Prep Facility	12'x15'=180	12'x15'=180	360	180	180
PI Auxiliary Lab	-----	2(15'x30')=360	900	900	---
Storage Room	4(7'x12')=336	-----	336	336	---
Offices	6(10'x10')=600	-----	600	600	---

PAGE 1 SUBTOTALS (ft²)

19930

15000

4930

TABLE 3. (page 2 of 3)

AREA/DISCIPLINE	KSC MEDICAL & RESEARCH PROJECTIONS (ft ²)	LSFE PROJECTION (ft ²)	RAW TOTAL (ft ²)	CONSOLIDATED REQTS/ PROJECTIONS (ft ²)	SPACE Δ DUE TO CONSOLIDATION (ft ²)
Med Examination Rooms	3(16'x14')=672	7(10'x10')=700	1372	700	672
Eye Examination Lab	12'x20'=240	12'x20'=240	480	240	240
Audio Lab	15'x15'=225	15'x15'=225	450	225	225
Emergency Treatment Area	15'x15'=225	15'x15'=225	450	225	225
Nurses Station	10'x15'=150	10'x15'=150	300	150	150
X-ray & Fluoroscopy	2(16'x14')=448	15'x15'=225	673	448	225
Change Room	8'x8'= 64	8'x8'= 64	128	64	64
Dark Room	10'x10'=100	10'x10'=100	200	100	100
Consultation & Med History	12'x12'=144	12'x12'=144	288	144	144
Blood Draw	12'x20'=240	12'x20'=240	480	240	240
Bioinstrumentation Lab	20'x40'=800	20'x20'=400	1200	1000	200
Electrical Repair Shop	20'x20'=400	20'x20'=400	800	400	400
Biotechnology Development	TBD	TBD	TBD	TBD	TBD
Data Acquisition & Processing	20'x25'=500	20'x25'=500	1000	1000	---
Tape & Data Storage	10'x20'=200		200	200	---
Laundry & Linen Storage	10'x15'=150	10'x15'=150	300	150	150
Lounge & Kitchen	15'x20'=300	15'x20'=300	600	300	300
Crew Food Prep	15'x20'=300		300	300	---
Shipping & Receiving		20'x30'=600	600	600	---
Storage					
Shipping Containers		20'x30'=600	600	600	---
Bonded Storage		20'x20'=400	400	400	---
Biochemical Storage	8'x10'=80	8'x10'=80	160	80	80
Micro Storage	8'x12'=96	8'x12'=96	192	96	96
Central Supply	15'x20'=300	15'x20'=300	600	300	300
General Storage	15'x20'=300		300	300	---

PAGE 2 SUBTOTALS

12073

8262

3811

TABLE 3. (page 3 of 3)

AREA/DISCIPLINE	KSC MEDICAL & RESEARCH PROJECTION (SPACE)(ft ²)	LSFE PROJECTION	RAW ² TOTAL (ft ²)	CONSOLIDATED REQTS/ PROJECTIONS (ft ²)	SPACE Δ DUE TO CONSOLIDATION (ft ²)
Rest Rooms (General)	4(15'x20')=1200	4(15'x20')=1200	2400	1200	1200
Rest Rooms (Bioassay)	2(8'x10')=160	2(8'x10')=160	320	160	160
Locker Showers (Resident)	2(10'x20')=400	2(10'x20')=400	800	400	400
Locker Showers (Test Subjects)	2(10'x30')=600	2(10'x30')=600	1200	600	600
Office (Resident)	10(12'x12')=1440	2(12'x12')=288	1728	1728	---
Office (PI)		20(12'x12')=2880	2880	2880	---
Office (Flight Crew Physicians)	4(12'x12')=576		576	576	---
Conference Room	15'x20'=300	25'x25'=625	925	625	300
Library	20'x30'=600	20'x30'=600	1200	600	600
Secretarial	2(15'x20')=600	15'x20'=300	900	900	---
Reception	2(15'x20')=600	15'x20'=300	900	600	300
Clerical					
Janitorial & Others	TBD	TBD	TBD	TBD	TBD

PAGE 3 SUBTOTALS

13829

10269

3560

RAW TOTAL
(ft²)CONSOLIDATED REQTS/
PROJECTIONS (ft²)SPACE Δ DUE TO
CONSOLIDATION (ft²)

PAGE 1 SUBTOTAL

19930

15000

4930

PAGE 2 SUBTOTAL

12073

8262

3811

PAGE 3 SUBTOTAL

13829

10269

3560

PAGE 1,2,AND 3 TOTAL (ft²)

45832

33531

12301

laboratories for the environmental monitoring program. It is suggested that these two areas receive the same detailed study to obtain the overall Biomedical Office space requirements. The inclusion of the Biomedical Office staff offices in the complex would greatly improve the efficiency of the use of time of the professional staff since they will be involved in the medical operations and the human experiment support programs. The environmental monitoring and study program can be located at other areas but could also gain by being at a common location and cross utilize the chemistry and microbiology laboratories proposed for inclusion in the integrated facility in this analysis.

7.2 Conclusions And Recommendations:

- A. A long-ranged overall plan should be completed to identify and schedule the development of crew, medical, and human life sciences research and experiment support facilities at KSC. Present facilities used in the human research and crew care should be considered interim and a new comprehensive integrated long-ranged approach be taken to develop the facilities that will be needed for KSC as Spaceport (East).
- B. The facility designs should make as prime goals the collocation and cross utilization of these human related facilities. Further, these facilities are recommended to be close to crew quarters as a means of reducing the amount of their time that will be spent for medical and research activities. It is also

recommended that the Biomedical Office staff offices be located adjacent to the human research and medical operations facilities to permit the efficient use of the professional staff time.

APPENDIX A

**Long-Term Facility Space Requirements and
Special Capabilities for Supporting STS Medical
Operations, Human Experiments and Intramural
Research at KSC (RAW DATA SHEETS)**

FLIGHT MEDICINE - AEROSPACE MEDICINE CLINIC
FOR CREW

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3. JSC 13856. Pre and Post Flight Food Service Plan.

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MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

KITCHEN & LOUNGE (STAFF - Research Lab, Aerospace Med Clinic, Microbiology)

AREA UTILIZATION SCENARIO:

For use by employees, PIs, and subjects who must arrive in fasting state

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Near clinical & stress lab

-AREA DIMENSIONS

10' x 20' including 8' x 10 kitchen area

-CEILING HT

9'

-FLOORING

Carpeted lounge with vinyl asbestos tile in kitchen area

-WALL SURFACE

Washable

-ACCESS/DOOR SIZE

External door - standard (large enough to fit couch)

-FIXED PLACE EQUIPMENT

Sink, stove, refrigerator, cabinets, dishwasher

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72°

-RELATIVE HUMIDITY
40-50 %

-CLEANLINESS
Easy clean

-LIGHTING
Controllable

-NOISE
Low

-ELECTRICAL POWER
110 V and 220 V

-GASES

-LIQUIDS
Water

-COMMUNICATIONS
Phone

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Janitorial service

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:
Sofa, chairs & tables in lounge area

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
EXAM ROOMS

AREA UTILIZATION SCENARIO:

Pre & post flight exams & data collection
General purpose rooms for all medical exams on crew members & families

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close to laboratory, x-ray, crew quarters, conference room; should provide good "flow" from one area to another; area should provide privacy

-AREA DIMENSIONS

10' x 10'

-CEILING HT

9'

-FLOORING

-WALL SURFACE

Smooth

-ACCESS/DOOR SIZE

4' x 7'

-FIXED PLACE EQUIPMENT

Sink

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72°

-RELATIVE HUMIDITY
40-50 %

-CLEANLINESS

-LIGHTING
75-85 FC with dimmer

-NOISE
< 50 decibels

-ELECTRICAL POWER
120 V, 1 Ø, 20 amp, 60 Hz

-GASES

-LIQUIDS
Hot & cold water

-COMMUNICATIONS
Telephone & paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

Exam table (with tilt, elevate & lower), dressing area, mirror,
cabinets, drawers; BP cuff & otoscope on wall

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
EYE EXAM

AREA UTILIZATION SCENARIO:

Pre & post flight exams - clinical support on crew members and families

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Close to other exam rooms

-AREA DIMENSIONS
12' x 20'

-CEILING HT
9'

-FLOORING
Carpet

-WALL SURFACE
Smooth, washable

-ACCESS/DOOR SIZE
4' x 7'

-FIXED PLACE EQUIPMENT
Sink with large cabinet, exam chair (raise & lower)

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72°

-RELATIVE HUMIDITY
40-50 %

-CLEANLINESS

-LIGHTING
65 FC with controllable dimmer

-NOISE
< 50 decibels

-ELECTRICAL POWER
120 V, 1 ϕ , 20 amp, 60 Hz

-GASES

-LIQUIDS
Hot & cold water

-COMMUNICATIONS
Telephone & paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

Slit lamp, peripheral vision board, refractive & photo examination equipment, cabinet & drawers for supplies, small desk or writing area

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
RESPIRATORY - PULMONARY LAB

AREA UTILIZATION SCENARIO:
Pre & post flight data collection; clinical support

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Close to exam rooms & x-ray & stress lab

-AREA DIMENSIONS
15' x 12'

-CEILING HT
9'

-FLOORING
Vinyl asbestos tile

-WALL SURFACE
Smooth, washable

-ACCESS/DOOR SIZE
4' x 7'

-FIXED PLACE EQUIPMENT
Sink

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72°

-RELATIVE HUMIDITY

45-50 %

-CLEANLINESS

-LIGHTING

65 FC

-NOISE

< 50 decibels

-ELECTRICAL POWER

120/208 V, 30 amp, 3 ϕ , 60 Hz

120 V, 20 amp, 1 ϕ , 60 Hz

-GASES

O₂, He, CO, N₂, CO₂

-LIQUIDS

H₂O with sink

-COMMUNICATIONS

Telephone & paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Terminal/CPU

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
CARDIOVASCULAR EXAM ROOM

AREA UTILIZATION SCENARIO:
Pre & post flight exams; clinical support of crew

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Close proximity to clinical areas

-AREA DIMENSIONS
15' x 15'

-CEILING HT
9'

-FLOORING

-WALL SURFACE
Smooth, washable

-ACCESS/DOOR SIZE
4' x 7'

-FIXED PLACE EQUIPMENT
Sink

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72°

-RELATIVE HUMIDITY

45-50 %

-CLEANLINESS

Visually Clean

-LIGHTING

65 FC

-NOISE

< 50 decibels

-ELECTRICAL POWER

120V, 1 Ø, 20 amp, 60 Hz

120 V, 1 Ø, 30 amp, 60 Hz

120/208 V, 1 Ø, 30 amp, 60 Hz

-GASES

Oxygen

-LIQUIDS

-COMMUNICATIONS

Telephone & paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Computer terminal

SPECIALIZED EQUIPMENT:

Phone & echocardiogram, 12 lead electrocardiograph machine, exam table, impedance cardiograph

OTHER REQUIREMENTS:

Instrumentation grounding

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
CONSULTATION ROOM - VIP WAITING ROOM

AREA UTILIZATION SCENARIO:

VIP waiting pre & post flight, in private, away from crew while crew is being examined, & away from press

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Close proximity to exam rooms

-AREA DIMENSIONS
12' x 12'

-CEILING HT
9'

-FLOORING
Carpet

-WALL SURFACE

-ACCESS/DOOR SIZE
3' x 7'

-FIXED PLACE EQUIPMENT

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72°

-RELATIVE HUMIDITY
40-50 %

-CLEANLINESS

-LIGHTING
60-75 FC controllable dimmer

-NOISE
< 45 decibels

-ELECTRICAL POWER

-GASES
NA

-LIQUIDS
NA

-COMMUNICATIONS
Telephone, telecon capability, paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:
Furniture

OTHER REQUIREMENTS:
TV, video recording machine

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
AEROSPACE MEDICINE CLINIC

AREA UTILIZATION SCENARIO:
X-ray Fluoroscopy

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Close proximity to clinic

-AREA DIMENSIONS
15' x 15' x-ray
10' x 10' Dark room & film storage
Dressing room
Viewing & reading area

-CEILING HT

-FLOORING

-WALL SURFACE
Lead lined

-ACCESS/DOOR SIZE
Lead lined

-FIXED PLACE EQUIPMENT
X-ray table - operator booth

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72°

-RELATIVE HUMIDITY

40-50 %

-CLEANLINESS

-LIGHTING

Dimmer (adjustable)

-NOISE

-ELECTRICAL POWER

120/208 V, 3 Ø, 100 amp, 60 Hz

-GASES

O₂

-LIQUIDS

-COMMUNICATIONS

Paging - phone

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
NURSES STATION

AREA UTILIZATION SCENARIO:

Nursing support for pre & post flight activities as well as clinical support for crew & family members

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to exam rooms & all clinic activities

-AREA DIMENSIONS

10' x 15'

-CEILING HT

9'

-FLOORING

Vinyl asbestos tile

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

4' x 7'

-FIXED PLACE EQUIPMENT

Sink, cabinets (with locks), drawers, desk

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72°

-RELATIVE HUMIDITY

45-50 %

-CLEANLINESS

Visually Clean

-LIGHTING

65 FC

-NOISE

< 50 decibels

-ELECTRICAL POWER

120 V, 20 amp, 1 ϕ , 60 Hz

-GASES

-LIQUIDS

Hot & cold water

-COMMUNICATIONS

Phone & paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Computer terminal

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
AEROSPACE MEDICINE CLINIC

AREA UTILIZATION SCENARIO:
Dental & ENT exam room

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Close proximity to clinic & x-ray

-AREA DIMENSIONS
15' x 15'

-CEILING HT
9'

-FLOORING
Tile

-WALL SURFACE
Smooth, washable

-ACCESS/DOOR SIZE
4' x 7'

-FIXED PLACE EQUIPMENT
Special chair, suction equipment, sink (EENT examining console and chair)

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72°

-RELATIVE HUMIDITY
40-50 %

-CLEANLINESS
Visually Clean

-LIGHTING
Controllable

-NOISE
Quiet

-ELECTRICAL POWER
120 V, 1 ϕ , 20 amp, 60 Hz

-GASES
O₂, nitrous oxide

-LIQUIDS
Running H₂O, sink

-COMMUNICATIONS
Phone, paging, computer terminal

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
AEROSPACE MEDICINE CLINIC

AREA UTILIZATION SCENARIO:
Auditory testing

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
In clinic area - away from heavy traffic areas in quiet region

-AREA DIMENSIONS
12' x 15'

-CEILING HT
9'

-FLOORING
Carpeting

-WALL SURFACE
Smooth, washable

-ACCESS/DOOR SIZE

-FIXED PLACE EQUIPMENT
Chamber with audiometer

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72°

-RELATIVE HUMIDITY
40-50 %

-CLEANLINESS

-LIGHTING
60 FC

-NOISE
< 45 decibels

-ELECTRICAL POWER
120 V, 1 Ø, 20 amp, 60 Hz

-GASES

-LIQUIDS

-COMMUNICATIONS
Phone

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
CPU terminal interface

SPECIALIZED EQUIPMENT:
Audiometer

OTHER REQUIREMENTS:
Thick-walled, sound proof chamber

CLINICAL AND RESEARCH LABORATORY
FOR CHEMISTRY AND HEMATOLOGY

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

CHEMISTRY & HEMATOLOGY LAB (CLINICAL LABS)

AREA UTILIZATION SCENARIO:

Support STS crew, research protocols, and PIs

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to phlebotomy area clinic, stress labs, and BDCF

-AREA DIMENSIONS

40' x 45'

-CEILING HT

9-10'

-FLOORING

Vinyl asbestos tile or Decotex

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

6' x 8' & 4' x 7' & 4' x 7'

-FIXED PLACE EQUIPMENT

Chemistry section (SMAC, ACA, Jordan refrigerator)

Hematology section (Coulter S+), fume hood

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72°F

-RELATIVE HUMIDITY

Controlled by AC/Heating - approximately 40 % RH

-CLEANLINESS

Very important - counter surfaces, walls, & floors must be immaculate & easily maintained

-LIGHTING

Variable 60-75 FC

-NOISE

< 50 decibels - suggest acoustic ceilings & panels to dampen instrument noise (high noise level for ACA)

UTILITIES:

-ELECTRICAL POWER

208, 3 Ø, 30 amp, 60 Hz

120, 1 Ø, 20 amp, 60 Hz

Dedicated lines for ACA, SMAC, & Coulter system. Suggest backup generator.

-GASES

? for HPLC & gas chromatography (had not included these systems previously)

-LIQUIDS

De-ionized water system, reagent grade #1, hot & cold tap water

-COMMUNICATIONS

Telephone, intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Secretarial help, files, computer word processor, data entry terminal (CRT), janitorial help

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

Gas chromatography & HPLC & TBD space requirement for equipment

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

PHLEBOTOMY - SAMPLE COLLECTION AREA (CLINICAL LABS)

AREA UTILIZATION SCENARIO:

Collect all blood, urine & stool samples

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Adjacent to hematology - chemistry labs

-AREA DIMENSIONS

15' x 20'

-CEILING HT

8-9'

-FLOORING

Vinyl asbestos tile

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

4' x 7'

-FIXED PLACE EQUIPMENT

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Very clean & easy to maintain

-LIGHTING
Good lighting required - 50-65 FC

-NOISE
< 50 decibels

UTILITIES:

-ELECTRICAL POWER
110 V, 1 Ø, 20 amp, 60 Hz

-GASES
NA

-LIQUIDS
Hot or cold H₂O at sink & in bathroom

-COMMUNICATIONS
Telephone, intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

Phlebotomy tables (2), blood drawing chairs

OTHER REQUIREMENTS:

Bathroom facilities

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
CLINICAL LABORATORY RECEPTION AREA

AREA UTILIZATION SCENARIO:
Receive and check in subjects for lab testing

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Adjacent to sample collection area close proximity to entrance & office

-AREA DIMENSIONS

10' x 20'

-CEILING HT

9'

-FLOORING

Carpet

-WALL SURFACE

Dry wall or vinyl

-ACCESS/DOOR SIZE

3' x 7'

-FIXED PLACE EQUIPMENT

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
Approximately 72°F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Visually Clean

-LIGHTING
65 FC

-NOISE
< 50 decibels

UTILITIES:

-ELECTRICAL POWER
120 V, 1 Ø, 15 amp, 60 Hz

-GASES
NA

-LIQUIDS
NA

-COMMUNICATIONS
Telephone, intercom, CRT to computer

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Janitorial service

SPECIALIZED EQUIPMENT:
Word processor

OTHER REQUIREMENTS:
Bathroom facility

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

RIA LAB FOR CLINICAL & RESEARCH WORK

AREA UTILIZATION SCENARIO:

Support STS crew, research protocols, principal investigators

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to chemistry lab

-AREA DIMENSIONS

15' x 20'

-CEILING HT

Standard height

-FLOORING

Tile

-WALL SURFACE

Smooth - painted or vinyl surface - easy to maintain

-ACCESS/DOOR SIZE

4' x 7'

-FIXED PLACE EQUIPMENT

counter, counter, 2-door refrigerator-freezer, isotope hood

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72°F

-RELATIVE HUMIDITY

Controlled by AC/heating system approximately 40 % RH

-CLEANLINESS

Counters, floors & walls must be immaculate & easily maintained

-LIGHTING

75 FC Sufficient to eliminate any shadows

-NOISE

Low level - instruments create increased noise level - suggest acoustic tiles in ceiling

UTILITIES:

-ELECTRICAL POWER

208 V, 3 Ø, 30 amp, 60 Hz, 120 V,

Dedicated lines for each scintillation counter

-GASES

Nitrogen tank for drying organic extracts

-LIQUIDS

De-ionized water system

-COMMUNICATIONS

Telephone & intercom to other lab areas

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Secretarial help, files, computer word processing capability,
Computer data entry, Janitorial help

SPECIALIZED EQUIPMENT:

counter, counter, refrigerated centrifuge, refrigerator, freezer,
vacuum pump, isotope fume hood
Sink, safety shower, counters, wall cases

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

IMMUNOLOGY LABORATORY FOR CLINICAL AND RESEARCH WORK

AREA UTILIZATION SCENARIO:

Support STS crews, research protocols, principal investigators

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to bacteriology & chemistry labs

-AREA DIMENSIONS

12' x 15'

-CEILING HT

9'

-FLOORING

Tile

-WALL SURFACE

Smooth - painted or vinyl. Easy to keep clean

-ACCESS/DOOR SIZE

4' x 7'

-FIXED PLACE EQUIPMENT

TBD

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72°F

-RELATIVE HUMIDITY

40-50 % RH governed by the AC/heating system

CLEANLINESS

Very important - counter surfaces, walls & floors must be immaculate

- should be easy to maintain

-LIGHTING

Sufficient to be shadowproof

75 FC

-NOISE

Low noise level

UTILITIES:

-ELECTRICAL POWER

120 V, 20 & 30 amp, 1 Ø, 60 Hz

-GASES

NA

-LIQUIDS

De-ionized water system

-COMMUNICATIONS

Intercom & telephone to other labs

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Secretarial help, files, computer word processing capability,
computer data entry, janitorial help

SPECIALIZED EQUIPMENT:

TBD

OTHER REQUIREMENTS:

Sink, counters and wall cases, safety shower

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

COMPUTER ROOM - DATA ACQUISITION & PROCESSING (CLINICAL LABS)

AREA UTILIZATION SCENARIO:

Data acquisition & processing

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Centrally located to all labs

-AREA DIMENSIONS
20' x 25'

-CEILING HT
10'

-FLOORING
False

-WALL SURFACE
Acoustic panels

-ACCESS/DOOR SIZE
6' x 8'

-FIXED PLACE EQUIPMENT

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
70°F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Visually Clean

-LIGHTING
60-75 FC

-NOISE
< 50 decibels

UTILITIES:

-ELECTRICAL POWER
120, 220

-GASES
NA

-LIQUID
NA

-COMMUNICATIONS
Telephone, intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Tie into user room - CRT in labs

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

Instrumentation power & grounding
Conditional power

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

BLOOD PROCESSING FOR CLINICAL & RESEARCH LABS

AREA UTILIZATION SCENARIO:

Support STS crews, research & clinical protocols, principal investigators

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

In close proximity to hematology & chemistry areas

-AREA DIMENSIONS

15' x 20'

-CEILING HT

Standard height 9'

-FLOORING

Tile (VAT) or Decotex

-WALL SURFACE

Painted or vinyl - easy to keep clean

-ACCESS/DOOR SIZE

Standard 4' x 7'

-FIXED PLACE EQUIPMENT

Counters, wallcases

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72°F

-RELATIVE HUMIDITY

Controlled by AC/heating system < 40 % RH

-CLEANLINESS

Counter surfaces, walls & floors must be immaculate and easy to maintain

-LIGHTING

Sufficient to be shadowproof 75 FC

-NOISE

Low level - Suggest acoustical ceilings to dampen equipment noise

UTILITIES:

-ELECTRICAL POWER

120, 220, power strips

-GASES

Co₂

-LIQUIDS

-COMMUNICATIONS

Telephone, intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Janitorial help

SPECIALIZED EQUIPMENT:

2 centrifuges, one refrigerated, ice-maker, dry icemaker, refrigerator, freezer, deep freeze.

Power supply back-up - alarms for refrigerator, freezer, deep freeze.

Sink, safety shower, plumbing for ice maker

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
OFFICE (CLINICAL LABS)

AREA UTILIZATION SCENARIO:
Secretarial help for all labs

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Close proximity to labs & computer room

-AREA DIMENSIONS
12' x 15'

-CEILING HT
9'

-FLOORING
Carpet

-WALL SURFACE
Smooth, washable

-ACCESS/DOOR SIZE
3' x 7'

-FIXED PLACE EQUIPMENT
NA

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Clean

-LIGHTING
65-70 FC

-NOISE
< 50 decibels

UTILITIES:

-ELECTRICAL POWER
120 V, 1 Ø, 15 amp, 60 Hz

-GASES
NA

-LIQUIDS
NA

-COMMUNICATIONS
Telephone, intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Janitorial help

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
LIBRARY (CLINICAL LABS)

AREA UTILIZATION SCENARIO:
For all personnel & PIs

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Centrally located to clinical labs, clinic, stress lab and to library data terminal room

-AREA DIMENSIONS

20' x 20'

-CEILING HT

9'

-FLOORING

Carpet

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

3' x 7'

-FIXED PLACE EQUIPMENT

Book cases

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Visually clean

-LIGHTING
Variable

-NOISE
Very low noise level

UTILITIES:

-ELECTRICAL POWER
120 V standard power

-GASES
NA

-LIQUIDS
NA

-COMMUNICATIONS

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

Writing tables & chairs, sofa & arm chair, end tables

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

BATHROOMS (4) (CLINICAL LABS)

AREA UTILIZATION SCENARIO:

1 in lab reception area, 1 in sample collection area, 2 off corridors & those designated in clinic & stress lab areas

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

See above

-AREA DIMENSIONS-

8' x 10'

-CEILING HT

9'

-FLOORING

Vinyl asbestos tile

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

3' x 7'

-FIXED PLACE EQUIPMENT

Plumbing, sinks, commodes

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
Controlled by AC/heating system

-CLEANLINESS
Very clean

-LIGHTING
Standard

-NOISE
Suggest some noise buffering

UTILITIES:

-ELECTRICAL POWER
120 V

-GASES
NA

-LIQUIDS
NA

-COMMUNICATIONS
NA

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
NA

SPECIALIZED EQUIPMENT:

Soap dispenser, towel dispenser, cabinet for supplies, sample transfer door from sample collecting bathroom to laboratory sample area.

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

CONFERENCE ROOM (CLINICAL LABS)

AREA UTILIZATION SCENARIO:

Meetings, TV, video, slide presentation for personnel & PIs

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Centrally located to clinical labs, clinic & stress lab

-AREA DIMENSIONS

15' x 20'

-CEILING HT

9'

-FLOORING

Carpet

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

3' x 7'

-FIXED PLACE EQUIPMENT

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Visually clean

-LIGHTING
Variable

-NOISE
Reasonably sound proof - suggest acoustical tile ceilings and/or other buffers

UTILITIES:

-ELECTRICAL POWER
120 V

-GASES
NA

-LIQUIDS
NA

-COMMUNICATIONS
Telephone, intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Janitorial help

SPECIALIZED EQUIPMENT:

TV, video recorder, slide projector, screen

OTHER REQUIREMENTS:

Blackboard, easel, podium, large table, comfortable chairs

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

EMPLOYEE LOUNGE/LOCKER ROOMS & BATHROOMS WITH SHOWERS (2) (CLINICAL LABS)

AREA UTILIZATION SCENARIO:

For use by all personnel & PIs

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Centrally located to clinical labs, clinic, stress lab

-AREA DIMENSIONS

10' x 20'

-CEILING HT

8' or 9'

-FLOORING

Ceramic tile or other suitable tile

-WALL SURFACE

Smooth, washable, mildew resistant

-ACCESS/DOOR SIZE

3' x 7'

-FIXED PLACE EQUIPMENT

Showers, commodes, sinks, lockers

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
Controlled by AC/heating system

-CLEANLINESS
Visually clean

-LIGHTING
Standard 120 V

-NOISE
Low noise level

UTILITIES:

-ELECTRICAL POWER
120 V

-GASES
NA

-LIQUIDS
NA

-COMMUNICATIONS

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

Lounge (sofa), chair, vanity table (women's locker room)

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

KITCHEN & LOUNGE AREA (CLINICAL LABS)

AREA UTILIZATION SCENARIO:

Use by all staff, PIs and subjects

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to stress & clinical labs

-AREA DIMENSIONS

15' x 20'

-CEILING HT

9'

-FLOORING

Vinyl asbestos tile in kitchen area, carpet in lounge area

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

3' x 7'

-FIXED PLACE EQUIPMENT

Sink, cabinets, dishwasher

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Visually clean

-LIGHTING
Standard 120 V

-NOISE
< 50 decibels

UTILITIES:

-ELECTRICAL POWER
120, 220V

-GASES
NA

-LIQUIDS
Hot & cold water for sinks

-COMMUNICATIONS
Telephone, intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

Dishwasher, refrigerator, microwave oven, small stove or hot plates

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

CLEAN-UP AREA FOR CLINICAL LABS

AREA UTILIZATION SCENARIO:

Glassware washing, cleaning of small items, such as mouthpieces, sterilization of small equipment, washing & drying towels, etc.

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

In close proximity to clinic, stress & clinic labs

-AREA DIMENSIONS

10' x 15'

-CEILING HT

9'

-FLOORING

Vinyl asbestos tile

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

3' x 7'

-FIXED PLACE EQUIPMENT

Dishwasher, sink, cabinets, closets for sweeper, cleaning equipment, washer, dryer

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
Controlled by AC/heating system

-CLEANLINESS
Very clean

-LIGHTING
60 FC

-NOISE

UTILITIES:

-ELECTRICAL POWER
120 V, 208 V, 1 Ø, 30 amp, 60 Hz

-GASES
NA

-LIQUIDS
Hot & cold H₂O, de-ionized water

-COMMUNICATIONS
Telephone

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

Exhaust venting over steam producing equipment

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

STORAGE & SUPPLY ROOM FOR CLINICAL LABS

AREA UTILIZATION SCENARIO:

Storage of bulk items

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to clinic, stress & clinical labs

-AREA DIMENSIONS

15' x 20'

-CEILING HT

9'

-FLOORING

Vinyl asbestos tile

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

4' x 8'

-FIXED PLACE EQUIPMENT

Shelves

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72-78°

-RELATIVE HUMIDITY
Controlled by AC/heat system

-CLEANLINESS
Visually clean

-LIGHTING
Variable

-NOISE

UTILITIES:

-ELECTRICAL POWER
120 V

-GASES
NA

-LIQUIDS
NA

-COMMUNICATIONS

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

Hand cart, dolly

OTHER REQUIREMENTS:

CLINICAL MICROBIOLOGY AND
ENVIRONMENTAL MICROBIOLOGY
(CLIN MICRO & ENVIRO MICRO)

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

AUTOClave ROOM (CLIN MICRO & ENVIRO MICRO LABS)

AREA UTILIZATION SCENARIO:

Support all microbiological operations

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Located between and adjacent to both the clinical and environmental microbiology labs

-AREA DIMENSIONS

15' x 15' (225 sq ft)

-CEILING HT

10'

-FLOORING

Decotex lab flooring

-WALL SURFACE

Epoxy (Smooth)

-ACCESS/DOOR SIZE

4'w x 7'h (2)

-FIXED PLACE EQUIPMENT

Two autoclaves, ETO gas tank racks, eye level storage cabinets, central floor drain

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

- TEMPERATURE
22°C (+ 2°C)
- RELATIVE HUMIDITY
60 % RH (+ 5%)
- CLEANLINESS
Class 100,000
- LIGHTING
Fluorescent 65 FC
- NOISE
< 50 decibels

UTILITIES

- ELECTRICAL POWER
110 V & 220 V, 1 Ø
- GASES
ETO
- LIQUIDS
Steam, tap water
- COMMUNICATIONS
Intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

ETO/steam sterilizer, as well as a steam autoclave (non ETO),
modular work benches

OTHER REQUIREMENTS:

Exhaust ventilation to outside, separate air handling system from
rest of laboratories

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

CLEAN ROOM (CLIN MICRO & ENVIRO MICRO LABS)

AREA UTILIZATION SCENARIO:

Used in dispensing media for all the microbiology laboratory operations

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Must be located between and adjacent to the environmental & clinical microbiology laboratories

-AREA DIMENSIONS

10' x 18' = 180 sq ft

-CEILING HT

8'

-FLOORING

Decotex lab flooring

-WALL SURFACE

Epoxy (Smooth)

-ACCESS/DOOR SIZE

4'w x 7'h (2)

-FIXED PLACE EQUIPMENT

Central floor drain

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

- TEMPERATURE
22°C (± 2°C)
- RELATIVE HUMIDITY
60 % RH (± 5%)
- CLEANLINESS
Class 100,000
- LIGHTING
Fluorescent 65 FC
- NOISE
< 50 decibels

UTILITIES

- ELECTRICAL POWER
110 V
- GASES
Propane
- LIQUIDS
None
- COMMUNICATIONS
Telephone, intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

(4) 8' Laminar flow benches

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

WASH ROOM (CLIN MICRO & ENVIRO MICRO LABS)

AREA UTILIZATION SCENARIO:

Used in support of all microbiology laboratory operations

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Must be located between and adjacent to the clinical & environmental microbiology labs

-AREA DIMENSIONS

15' x 15' = 225 sq ft

-CEILING HT

10'

-FLOORING

Decotex lab flooring

-WALL SURFACE

Epoxy (Smooth)

-ACCESS/DOOR SIZE

4'w x 7'h (2)

-FIXED PLACE EQUIPMENT

Dishwasher, dryer, eye level storage cabinets, sink, central floor drain, work bench areas

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

- TEMPERATURE
22°C (± 2°C)
- RELATIVE HUMIDITY
60 % RH (± 5%)
- CLEANLINESS
Class 100,000
- LIGHTING
Fluorescent 65 FC
- NOISE
< 50 decibels

UTILITIES

- ELECTRICAL POWER
110 V & 220 V
- GASES
High pressure air line (100 psi)
- LIQUIDS
Demineralized H₂O (millipore), tap water, hot water
- COMMUNICATIONS
Telephone, intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

Vernitron - better built dishwasher & dryer

OTHER REQUIREMENTS:

Exhaust vent to outside - should be on same air handling system as autoclave room

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
ENVIRONMENTAL MICROBIOLOGY

AREA UTILIZATION SCENARIO:
Support LSSF, and pre and postflight operations

PHYSICAL:

- INTERRELATIONSHIP TO OTHER AREAS
Adjacent to clinical micro autoclaves & glassware washer & dryer

- AREA DIMENSIONS
15' x 30' (450 sq ft)

- CEILING HT
10'

- FLOORING
Decotex lab flooring

- WALL SURFACE
Epoxy (Smooth)

- ACCESS/DOOR SIZE
5'w x 8'h

- FIXED PLACE EQUIPMENT
Sink, center floor drain

- LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE

22°C (\pm 2°C)

-RELATIVE HUMIDITY

60 % RH (\pm 5%)

-CLEANLINESS

Class 100,000

-LIGHTING

Fluorescent 65 FC

-NOISE

< 50 decibels

UTILITIES

-ELECTRICAL POWER

110 V & 220 V

-GASES

Propane

-LIQUIDS

Tap water, DI water

-COMMUNICATIONS

Telephone, intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

Laminar flow bench - 2 6' benches, refrigerator (triple door), incubators 30°C, 35°C, 44.5°C, modular work benches, wall cabinets

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
CLINICAL MICROBIOLOGY LABORATORY

AREA UTILIZATION SCENARIO:
Support clinical microbiology and experimental clinical micro.
operations

PHYSICAL:

- INTERRELATIONSHIP TO OTHER AREAS
Adjacent to washroom, autoclave room, and clean room

- AREA DIMENSIONS
15' x 30' = 450 sq ft

- CEILING HT
10'

- FLOORING
Decotex lab flooring

- WALL SURFACE
Epoxy (Smooth)

- ACCESS/DOOR SIZE
54"w x 8'h

- FIXED PLACE EQUIPMENT
Sink, central floor drain, drain for CO₂ incubator, shower/eye wash
station, chem. fume hood, eye level storage cabinets (wall mounted)

- LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

- TEMPERATURE
22°C (\pm 2°C)
- RELATIVE HUMIDITY
60 % RH (\pm 5%)
- CLEANLINESS
Class 100,000
- LIGHTING
Fluorescent 65 FC
- NOISE
< 50 decibels

UTILITIES

- ELECTRICAL POWER
110 V & 220 V
- GASES
Propane, CO₂
- LIQUIDS
Deminerlized H₂O (millipore), tap water
- COMMUNICATIONS
Telephone, intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

Baker 6' Biological Safety Cabinet, eye wash & shower station, chemical fume hood, CO₂ & non CO₂ incubators, -70°C freezer, triple door refrigerator, modular work benches

OTHER REQUIREMENTS:

Be on separate air handling system from autoclave room and wash room

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
MYCOLOGY LAB

AREA UTILIZATION SCENARIO:

Support environmental, clinical microbiology labs and pre and post STS support

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Adjacent to microbiology labs

-AREA DIMENSIONS
10' x 20'

-CEILING HT
10'

-FLOORING
Decotex lab flooring

-WALL SURFACE
Epoxy (Smooth)

-ACCESS/DOOR SIZE
54"w x 8'h

-FIXED PLACE EQUIPMENT
Sink, floor drain

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

- TEMPERATURE
22°C (\pm 2°C)
- RELATIVE HUMIDITY
60 % RH (\pm 5%)
- CLEANLINESS
Class 100,000
- LIGHTING
Fluorescent 65 FC
- NOISE
< 50 decibels

UTILITIES

- ELECTRICAL POWER
110 V
- GASES
Propane, CO₂
- LIQUIDS
DI H₂O, tap water
- COMMUNICATIONS
Telephone, intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

Baker Biological Safety Cabinet, microscope, stereoscope, incubator

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

FLUORESCENT MICROSCOPY ROOM (CLIN MICRO & ENVIRO MICRO LABS)

AREA UTILIZATION SCENARIO:

To be utilized by all microbiological operations

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

To be placed in the clinical microbiology area

-AREA DIMENSIONS

8' x 8' (64 sq ft)

-CEILING HT

10'

-FLOORING

Decotex lab flooring

-WALL SURFACE

Epoxy (Smooth)

-ACCESS/DOOR SIZE

3' x 7'

-FIXED PLACE EQUIPMENT

None

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

- TEMPERATURE
22°C (+ 2°C)
- RELATIVE HUMIDITY
60 % RH (+ 5%)
- CLEANLINESS
Class 100,000
- LIGHTING
Fluorescent 65 FC
- NOISE
< 50 decibels

UTILITIES

- ELECTRICAL POWER
110 V
- GASES
None
- LIQUIDS
None
- COMMUNICATIONS
Intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

Fluorescent microscope - Olympus

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

AUXILIARY LABORATORY I - possible use by PI (for his/her own use)
(CLIN MICRO & ENVIRO MICRO LABS)

AREA UTILIZATION SCENARIO:

Support experimental microbiology performed by a PI who requires his/her own facilities

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Should be located near either the environmental or clinical micro lab

-AREA DIMENSIONS

15' x 30' (450 sq ft)

-CEILING HT

10'

-FLOORING

Decotex lab flooring

-WALL SURFACE

Epoxy (Smooth)

-ACCESS/DOOR SIZE

54" w x 8' h

-FIXED PLACE EQUIPMENT

Central floor drain, sink, chemical fume hood, safety shower/eyewash station, eye level storage cabinets

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

- TEMPERATURE
22°C (\pm 2°C)
- RELATIVE HUMIDITY
60 % RH (\pm 5%)
- CLEANLINESS
Class 100,000
- LIGHTING
Fluorescent 65 FC
- NOISE
< 50 decibels

UTILITIES

- ELECTRICAL POWER
110 V & 220 V
- Propane, C₃H₈
- LIQUIDS
Demineralized H₂O (millipore), tap water
- COMMUNICATIONS
Telephone, intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

Safety shower/eye wash station

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

AUXILIARY LABORATORY II - used as a tissue/virology laboratory
(CLIN MICRO & ENVIRO MICRO LABS)

AREA UTILIZATION SCENARIO:

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Located near either the clinical or environmental microbiology laboratory

-AREA DIMENSIONS

15' x 30' (450 sq ft)

-CEILING HT

10'

-FLOORING

Decotex lab flooring

-WALL SURFACE

Epoxy (Smooth)

-ACCESS/DOOR SIZE

54" w x 8' h

-FIXED PLACE EQUIPMENT

Central floor drain, sink, chemical frume hood, safety shower/eye wash station, eye level cabinets

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

- TEMPERATURE
22°C (\pm 2°C)
- RELATIVE HUMIDITY
60 % RH (\pm 5%)
- CLEANLINESS
Class 100,000
- LIGHTING
Fluorescent 65 FC
- NOISE
< 50 decibels

UTILITIES

- ELECTRICAL POWER
110 V & 220 V
- GASES
Propane, CO₂
- LIQUIDS
Demineralized H₂O (Culligan), tap water
- COMMUNICATIONS
Telephone, intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

Safety shower/eye wash station

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

STORAGE ROOMS (4) (CLIN MICRO & ENVIRO MICRO LABS)

AREA UTILIZATION SCENARIO:

One for each lab

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Located within or adjacent to each laboratory (except mycology)

-AREA DIMENSIONS

7' x 12' = 84 sq ft x 4 = 336 sq ft

-CEILING HT

10'

-FLOORING

Decotex lab flooring

-WALL SURFACE

Epoxy (Smooth)

-ACCESS/DOOR SIZE

3' x 7'

-FIXED PLACE EQUIPMENT

None

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE

22°C (± 2°C)

-RELATIVE HUMIDITY

60 % RH (± 5%)

-CLEANLINESS

Class 100,000

-LIGHTING

Fluorescent 65 FC

-NOISE

< 50 decibels

UTILITIES

-ELECTRICAL POWER

None

-GASES

None

-LIQUIDS

None

-COMMUNICATIONS

None

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

None

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

OFFICES (6) (CLIN MICRO & ENVIRO MICRO LABS)

AREA UTILIZATION SCENARIO:

For use in supporting the clinical, environmental and auxiliary micro lab operations

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Should be located near the laboratories

-AREA DIMENSIONS

10' x 10' (100 sq ft) x 6 = 600 sq ft

-CEILING HT

8'

-FLOORING

Decotex lab flooring

-WALL SURFACE

Epoxy (Smooth)

-ACCESS/DOOR SIZE

3' x 6'

-FIXED PLACE EQUIPMENT

CRT

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

- TEMPERATURE
22°C (± 2°C)
- RELATIVE HUMIDITY
60 % RH (± 5%)
- CLEANLINESS
Class 100,000
- LIGHTING
Fluorescent 65 FC
- NOISE
< 50 decibels

UTILITIES

- ELECTRICAL POWER
110 V
- GASES
None
- LIQUIDS
None
- COMMUNICATIONS
Telephone, intercom

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
CRT in each office

SPECIALIZED EQUIPMENT:
Computer terminal

OTHER REQUIREMENTS:

LIFE SCIENCES FLIGHT EXPERIMENTS

SUPPORT FACILITY

(LSFE)

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
LSFE/NURSES STATION

AREA UTILIZATION SCENARIO:
Nursing support for pre & postflight medical exams

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Adjacent to medical exam area

-AREA DIMENSIONS
12' x 15' = 180 sq ft

-CEILING HT
9'

-FLOORING
Vinyl asbestos tile

-WALL SURFACE
Smooth

-ACCESS/DOOR SIZE
3' x 7'

-FIXED PLACE EQUIPMENT
TBD

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
70-72°F

-RELATIVE HUMIDITY
40-50 % RH

-CLEANLINESS
Visually clean

-LIGHTING
60 FC

-NOISE
< 50 decibels

UTILITIES

-ELECTRICAL POWER
120 v, 1 Ø, 15 amp, 60 Hz

-GASES
NA

-LIQUIDS
Sink, hot & cold water

-COMMUNICATIONS
Telephone, paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
TBD

SPECIALIZED EQUIPMENT:
TBD

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE RESPIRATORY/PULMONARY LAB

AREA UTILIZATION SCENARIO:

Pre & postflight data collection and examination

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Should be in close proximity to stress lab and exam suite

-AREA DIMENSIONS

12' x 15' = 180

-CEILING HT

10'

-FLOORING

Vinyl asbestos tile

-WALL SURFACE

Smooth

-ACCESS/DOOR SIZE

4' x 7'

-FIXED PLACE EQUIPMENT

TBD

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

TBD

ENVIRONMENT:

-TEMPERATURE
70-72°F

-RELATIVE HUMIDITY
40-50 % RH

-CLEANLINESS
Visually clean

-LIGHTING
65-75 FC

-NOISE
< 55 decibels

UTILITIES

-ELECTRICAL POWER
120, 15 amp, 1 ϕ , 60 Hz
120/208, 30 amp, 3 ϕ , 60 Hz

-GASES
Oxygen, others TBD

-LIQUIDS
TBD

-COMMUNICATIONS
Telephone, paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
TBD

SPECIALIZED EQUIPMENT:
TBD

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
LSFE CENTRAL SUPPLY AREA

AREA UTILIZATION SCENARIO:

In addition to area specific storage areas a central area should be available for bulk quantities and large items

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Close proximity

-AREA DIMENSIONS
25' x 15' = 375 sq ft

-CEILING HT
10'

-FLOORING
Vinyl asbestos tile

-WALL SURFACE
Dry wall

-ACCESS/DOOR SIZE
6' x 8' or 4' x 7'

-FIXED PLACE EQUIPMENT
TBD

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72°F

-RELATIVE HUMIDITY

40-50 % RH

-CLEANLINESS

Visually clean

-LIGHTING

60 FC

-NOISE

< 55 decibels

UTILITIES

-ELECTRICAL POWER

120, 1 Ø, 15 amp, 60 Hz

-GASES

NA

-LIQUIDS

NA

-COMMUNICATIONS

Telephone, paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

Shelving

Office in nearby area for supply and logistics clerk

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
LSFE/EYE EXAM AREA

AREA UTILIZATION SCENARIO:
LSFE pre and postflight as well as clinical support area

PHYSICAL:

- INTERRELATIONSHIP TO OTHER AREAS
Close proximity to medical exam suite
- AREA DIMENSIONS
12' x 20' = 240
- CEILING HT
9'
- FLOORING
Vinyl asbestos tile
- WALL SURFACE
Smooth, washable
- ACCESS/DOOR SIZE
4' x 7'
- FIXED PLACE EQUIPMENT
Examination refractometer & photo examination light, tenometer,
perimeter, slit lamp
- LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72°F

-RELATIVE HUMIDITY

40-50 % RH

-CLEANLINESS

Visually clean

-LIGHTING

60 FC

-NOISE

< 55 decibels

UTILITIES

-ELECTRICAL POWER

120, 1 Ø, 15 amp, 60 Hz

-GASES

NA

-LIQUIDS

NA

-COMMUNICATIONS

Telephone, paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

Shelving

Office in nearby area for supply and logistics clerk

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
LSFE/CONFERENCE ROOM

AREA UTILIZATION SCENARIO:
Provide meeting area for visiting investigators and resident staff

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Should be in close proximity to administrative areas

-AREA DIMENSIONS
25' x 40' = 1000 sq ft

-CEILING HT
10'

-FLOORING
Carpet

-WALL SURFACE
Acoustic tiles

-ACCESS/DOOR SIZE
3' x 7'

-FIXED PLACE EQUIPMENT
NA

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

- TEMPERATURE
70-72°F
- RELATIVE HUMIDITY
40-50 % RH
- CLEANLINESS
Standard
- LIGHTING
60-75 FC controllable dimmer
- NOISE
< 45 decibels

UTILITIES

- ELECTRICAL POWER
120, 1 Ø, 5 amp, 60 Hz
- GASES
NA
- LIQUIDS
NA
- COMMUNICATIONS
Telephone, telecon capability, air to ground monitor only

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

Viewgraph and associated screens
Conference table & chairs

OTHER REQUIREMENTS:

OTV
Mission time clocks

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE/RECEPTION & GENERAL CLERICAL SUPPORT AREA

AREA UTILIZATION SCENARIO:

Receiving/checking in and screening area to entrance of LSFE support areas

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to office areas and close proximity to entrance

-AREA DIMENSIONS

20' x 30' = 600 sq ft

-CEILING HT

9'

-FLOORING

Vinyl asbestos tile or carpet

-WALL SURFACE

Dry wall or vinyl

-ACCESS/DOOR SIZE

6' x 7' or 3' x 7'

-FIXED PLACE EQUIPMENT

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

NA

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
40-50 % RH

-CLEANLINESS
Visually clean

-LIGHTING
65 FC

-NOISE
< 50 decibels

UTILITIES

-ELECTRICAL POWER
120 V, 1 Ø, 15 amp, 60 Hz

-GASES
NA

-LIQUIDS
NA

-COMMUNICATIONS
Telephone, paging, terminals to CPU

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Tape or disc storage

SPECIALIZED EQUIPMENT:

Word processor (2)

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
LSFE/MICROBIOLOGY PREP AREA

AREA UTILIZATION SCENARIO:

Required for PI preflight prep of cell and tissue cultures - also
for postflight analysis

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Should be collocated adjacent to microbiology lab and support areas

-AREA DIMENSIONS

15' x 25' = 375 sq ft

-CEILING HT

9'-10'

-FLOORING

Decotex lab floor

-WALL SURFACE

Smooth, washable (epoxy paint)

-ACCESS/DOOR SIZE

4' x 7'

-FIXED PLACE EQUIPMENT

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
70° F

-RELATIVE HUMIDITY
40-50 % RH

-CLEANLINESS
100 K

-LIGHTING
75 FC

-NOISE
< 50 decibels

UTILITIES

-ELECTRICAL POWER
120 V, 1 Ø, 15 & 30 amp, 60 Hz
120/208, 3 Ø, 30 amp, 60 Hz

-GASES
LPC, vacuum & air

-LIQUIDS
Hot & cold water with sink
DI H₂O

-COMMUNICATIONS
Telephone, paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

Laminar flow bench
Incubators

OTHER REQUIREMENTS:

Should share microscopy and other micro support areas

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE/XRAY & FLUOROSCOPY

AREA UTILIZATION SCENARIO:

Support flight experiment data collection and clinical areas

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to medical exam area

-AREA DIMENSIONS

15' x 15' X-ray	= 225 sq ft
10' x 10' Dark room & film storage	= 100 sq ft
8' x 8' Change room	= 64 sq ft

-CEILING HT

10' or as required by unit selected

-FLOORING

Vinyl asbestos tile

-WALL SURFACE

Smooth, washable/lead lined

-ACCESS/DOOR SIZE

4' x 7' lead lined

-FIXED PLACE EQUIPMENT

X-ray system & operator booth
Film processor

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72°F

-RELATIVE HUMIDITY

40-50 % RH

-CLEANLINESS

Visually clean

-LIGHTING

60-75 FC (controllable dimmer)

-NOISE

< 50 decibels

UTILITIES

-ELECTRICAL POWER

120/208 V, 3 ϕ , 100 amp, 60 Hz

120 V, 1 ϕ , 20 amp, 60 Hz

-GASES

NA

-LIQUIDS

NA

-COMMUNICATIONS

Telephone, paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

SPECIALIZED EQUIPMENT:

TBD

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE/LOCKER SHOWER AREA

AREA UTILIZATION SCENARIO:

Crew/test subject change room and shower

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to cardiovascular lab & BDCF

-AREA DIMENSIONS

15' x 25' = 375 sq ft Male

15' x 25' = 375 sq ft Female

-CEILING HT

9'

-FLOORING

Tile

-WALL SURFACE

Smooth, washable or tile

-ACCESS/DOOR SIZE

3' x 7'

-FIXED PLACE EQUIPMENT

Lockers and standard bathroom fixtures

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE

75°F

-RELATIVE HUMIDITY

40-65 % RH

-CLEANLINESS

Visually clean

-LIGHTING

60-75 FC

-NOISE

< 55 decibels

UTILITIES

-ELECTRICAL POWER

120 V, 1 Ø, 15 amp, 60 Hz

-GASES

NA

-LIQUIDS

Hot & cold water at sink areas, shower, and commode

-COMMUNICATIONS

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

NA

SPECIALIZED EQUIPMENT:

NA

OTHER REQUIREMENTS:

Central location

Potential need for 2 separate sets

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE GENERAL PURPOSE LABS

AREA UTILIZATION SCENARIO:

Generic work areas for visiting investigators for preflight preparation postflight processing and analysis

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to all - short walking distance

-AREA DIMENSIONS

3 - 15' x 15' = 225/rm = 675 sq ft

2 - 12' x 20' = 240/rm = 480 sq ft

-CEILING HT

10'

-FLOORING

Solid/Decotex

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

4' x 7'

-FIXED PLACE EQUIPMENT

Fume hoods in 3 labs (isotope rated)

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

TBD

ENVIRONMENT:

-TEMPERATURE
70-72°F

-RELATIVE HUMIDITY
40-50 % RH

-CLEANLINESS
Visually clean

-LIGHTING
75 FC

-NOISE
< 50 decibels

UTILITIES

-ELECTRICAL POWER
120 V, 1 Ø, 20 & 30 amp, 60 Hz
120/208, 3 Ø, 30 amp, 60 Hz

-GASES
Stub ups for air, vac, and LPG

-LIQUIDS
H₂O hot & cold with flex hose adapter to modular furniture and sink
DI H₂O

-COMMUNICATIONS
Telephone, paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
TBD

SPECIALIZED EQUIPMENT:
TBD

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE/HEARING CHAMBER AND AUDIO LAB

AREA UTILIZATION SCENARIO:

Pre & postflight data collection

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

To be located in closest proximity to med exam area

-AREA DIMENSIONS

15' x 15' including chamber = 225 sq ft

-CEILING HT

9'

-FLOORING

Vinyl asbestos tile or carpet

-WALL SURFACE

Acoustic panels

-ACCESS/DOOR SIZE

3' x 7'

-FIXED PLACE EQUIPMENT

Chamber with audiometer

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72° F

-RELATIVE HUMIDITY
40-50 % RH

-CLEANLINESS
Visually clean

-LIGHTING
60 FC

-NOISE
< 45 decibels

UTILITIES

-ELECTRICAL POWER
120 V, 1 Ø, 15 amp, 60 Hz

-GASES
NA

-LIQUIDS
NA

-COMMUNICATIONS
On/Off light in chamber

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
TBD

SPECIALIZED EQUIPMENT:
TBD

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE/PI/STAFF KITCHEN & LOUNGE

AREA UTILIZATION SCENARIO:

Close proximity to all other LSFE support and Biomed areas

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Support for off hour testing and critical timelines (i.e, R+0)

-AREA DIMENSIONS

15' x 20' = 300 sq ft with dining area

-CEILING HT

9'

-FLOORING

Vinyl asbestos tile

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

3' x 7'

-FIXED PLACE EQUIPMENT

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72° F

-RELATIVE HUMIDITY
40-50 % RH

-CLEANLINESS
Visually clean

-LIGHTING
60-70 FC

-NOISE
< 55 decibels

UTILITIES

-ELECTRICAL POWER
120 V, 1 ϕ , 15 amp, 60 Hz
120/208, 3 ϕ , 30 amp, 60 Hz

-GASES
NA

-LIQUIDS
Sink with hot & cold H₂O
Stubs for dishwasher

-COMMUNICATIONS
Telephone, paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
NA

SPECIALIZED EQUIPMENT:

Stove, microwave, refrigerator, dishwasher

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE/CENTRAL DATA DISTRIBUTION AND ACQUISITION AREA

AREA UTILIZATION SCENARIO:

Would house the Biomed CPU and provide an area adjacent for PI computer systems

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Centrally located to all areas adjacent to bioinstrumentation lab and ground control labs

-AREA DIMENSIONS

Biomed office data room - 20' x 25' = 500 sq ft
PI mission support area - 15' x 20' = 300 sq ft

-CEILING HT

10' from false floor to ceiling

-FLOORING

False

-WALL SURFACE

Acoustic panels

-ACCESS/DOOR SIZE

6' x 8'

-FIXED PLACE EQUIPMENT

Conditioned power rack or access to

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
70°F

-RELATIVE HUMIDITY
40-50 % RH

-CLEANLINESS
Visually clean

-LIGHTING
60-75 FC

-NOISE
< 50 decibels

UTILITIES

-ELECTRICAL POWER
480 V, 3 Ø, 50 amp, 60 Hz
120 V, 1 Ø, 20 & 30 amp, 60 Hz
120/208 V, 3 Ø, 30 amp, 60 Hz

-GASES
NA

-LIQUIDS
NA

-COMMUNICATIONS
Telephone, paging, OIS

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Tie into user rooms 1263 O&C data distribution system, and LSSF

SPECIALIZED EQUIPMENT:

TBD

OTHER REQUIREMENTS:

Uninterrupted and emergency power supply, instrumentation power and grounding

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE/CONSULTATION AND MEDICAL HISTORY

AREA UTILIZATION SCENARIO:

Support to crew members/test subjects and possibly family

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to exam suite and records

-AREA DIMENSIONS

12' x 12' = 144 sq ft

-CEILING HT

9'

-FLOORING

Vinyl asbestos tile or carpet

-WALL SURFACE

White

-ACCESS/DOOR SIZE

3' x 7'

-FIXED PLACE EQUIPMENT

NA

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72°F

-RELATIVE HUMIDITY

40-60 % RH

-CLEANLINESS

Visually clean

-LIGHTING

60 FC

-NOISE

< 50 decibels

UTILITIES

-ELECTRICAL POWER

120 V, 1 Ø, 15 amp, 60 Hz

-GASES

NA

-LIQUIDS

NA

-COMMUNICATIONS

Telephone, paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

NA

SPECIALIZED EQUIPMENT:

TBD

OTHER REQUIREMENTS:

X-ray viewing screen

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE/BIO ASSAY SUPPORT LABORATORY

AREA UTILIZATION SCENARIO:

Provide LSFE biochemical analysis and clinical analysis in support of test subjects, crew and crew family, provide bio assay for non human experiments program as required.

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to blood draw area, exam area, BDCF

-AREA DIMENSIONS

Hematology	= 15' x 30' = 450 sq ft
R/A	= 15' x 20' = 300 sq ft
Storage	= 10' x 20' = 200 sq ft
Chemistry	= 20' x 30' = 600 sq ft
Blood processing	= 15' x 20' = 300 sq ft

-CEILING HT

9'- 10'

-FLOORING

Vinyl asbestos tile or lab flooring (Decotex)

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

6' x 8' & 4' x 8'

-FIXED PLACE EQUIPMENT

Isotope & chemical fume hoods

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

TBD

ENVIRONMENT:

- TEMPERATURE
70-72°F
- RELATIVE HUMIDITY
40-50 % RH
- CLEANLINESS
100 K
- LIGHTING
75-85 FC
- NOISE
< 50 decibels

UTILITIES

- ELECTRICAL POWER
120 V, 1 ϕ , 20 & 30 amp, 60 Hz
240 V, 1 ϕ , 30 amp, 60 Hz
120/208 V, 3 ϕ , 30 amp, 60 Hz
- GASES
Vac, air, LPG, Helium, Hydrogen, Argon, others TBD, to gas chromatograph
- LIQUIDS
Hot & cold H₂O with sink, DI H₂O (class TBD)
- COMMUNICATIONS
Telephone, paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Terminal and interface with CPU

SPECIALIZED EQUIPMENT:

TBD

OTHER REQUIREMENTS:

Instrumentation power

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
LSFE/CARDIOVASCULAR LAB

AREA UTILIZATION SCENARIO:

In support of pre and postflight data collection SL-4 proposed experimentation includes cardiovascular deconditioning, SL-1 experimentation includes 3 D ballistocardiograph. High potential for cardiovascular research and exercise programs for a 0 G environment.

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Requires close proximity to locker shower area, prep room, emergency medical services/capabilities, crew quarters, and hydrostatic weighing facility.

-AREA DIMENSIONS

40' x 25' = 1000 sq ft

-CEILING HT

12'

-FLOORING

Vinyl asbestos tile

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

6' x 8'

-FIXED PLACE EQUIPMENT

TBD

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72⁰F

-RELATIVE HUMIDITY

40-50 % RH

-CLEANLINESS

Visually clean

-LIGHTING

75 FC

-NOISE

< 50 decibels

UTILITIES

-ELECTRICAL POWER

120 V, 1 ϕ , 20 & 30 amp, 60 Hz

120/208, 3 ϕ , 30 amp, 60 Hz

250 V, 1 ϕ , 30 amp, 60 Hz

-GASES

Oxygen, others TBD

-LIQUIDS

Hot & cold H₂O in prep area (adjacent)

-COMMUNICATIONS

Telephone, paging, OIS

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Terminal connection to Biomed CPU

SPECIALIZED EQUIPMENT:

EKG (2), treadmills (3), bicycle ergometer (2), O₂ analyzer (2),
brush recorders

OTHER REQUIREMENTS:

Instrumentation power & grounding

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE/BIOINSTRUMENTATION LAB

AREA UTILIZATION SCENARIO:

To support calibration following shipment, hardware/systems development, systems trouble shooting, check out calibration and integration of new equipment and modified systems

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to electrical repair shop and baseline data collection area

-AREA DIMENSIONS

30' x 40' = 1200 sq ft

-CEILING HT

10'

-FLOORING

Vinyl asbestos tile

-WALL SURFACE

Acoustic panels for sound absorption

-ACCESS/DOOR SIZE

6' x 8'

-FIXED PLACE EQUIPMENT

Conditioned power system

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

TBD

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
40-50 % RH

-CLEANLINESS
Visually clean

-LIGHTING
75-85 FC

-NOISE
< 45 decibels

UTILITIES

-ELECTRICAL POWER
120 V, 1 Ø, 20 & 30 amp, 60 Hz
120/208 V, 3 Ø, 30 amp, 60 Hz
480 V, 3 Ø, 50 amp, 60 Hz
28 V DC

-GASES
Air & vacuum

-LIQUIDS
NA

-COMMUNICATIONS
Telephone, paging, terminal tie in to CPU and BDCF, OIS

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
TBD

SPECIALIZED EQUIPMENT:
Brush recorders, instrument tape recorders, oscilloscope, etc.

OTHER REQUIREMENTS:
Instrumentation power and grounding

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE MEDICAL EXAMINATION AREAS

AREA UTILIZATION SCENARIO:

Required to provide pre and postflight exams, clinical exams for crew members and families while at KSC, pre test exams for Baseline data collection

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity required to crew quarters and BDCF areas - movement of crew and time should be kept at a minimum - also efficient use of PI and KSC support staff time - access to emergency medical capabilities

-AREA DIMENSIONS

7 rooms 10' x 10' in size = 700 sq ft

-CEILING HT

Standard 8' or 9'

-FLOORING

Vinyl asbestos tile

-WALL SURFACE

Smooth, white, washable

-ACCESS/DOOR SIZE

4' x 7'

-FIXED PLACE EQUIPMENT

NA

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72⁰ F

-RELATIVE HUMIDITY
40-60 % RH

-CLEANLINESS
Visually clean

-LIGHTING
75-85 FC with dimmer

-NOISE
< 50 decibels

UTILITIES

-ELECTRICAL POWER
5, 120 V, 1 ϕ , 20 amp, 60 Hz
1, 120/208, 3 ϕ , 30 amp, 60 Hz

-GASES
None facilitized

-LIQUIDS
Hot & cold H₂O with sink in each room

-COMMUNICATIONS
Paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
TBD

SPECIALIZED EQUIPMENT:

Examination tables, small writing platform or desk, supply cabinet
(stainless steel, lockable), others TBD

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE GENERAL SUPPORT LINEN WASH/DRY & STORAGE AREA

AREA UTILIZATION SCENARIO:

Close proximity to examination suite, hydrostatic weighing facility, stress lab - for in-house washing and storage of towels, lab coats, robes, etc.

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

See above

-AREA DIMENSIONS

10' x 15' area = 150 sq ft

-CEILING HT

9' Standard

-FLOORING

Vinyl asbestos tile

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

4' x 7'

-FIXED PLACE EQUIPMENT

Washer & dryer, storage cabinets

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72°F

-RELATIVE HUMIDITY

40-60 % RH

-CLEANLINESS

Clean (standard)

-LIGHTING

70 FC

-NOISE

< 55 decibels

UTILITIES

-ELECTRICAL POWER

4, 120 V, 1 Ø, 30 amp, 60 Hz

1, 120/208 V, 3 Ø, 30 amp, 60 Hz

-CASES

NA

-LIQUIDS

Hot & cold H₂O at washer and at sink (deep basin, double)

-COMMUNICATIONS

Paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

None

SPECIALIZED EQUIPMENT:

None

OTHER REQUIREMENTS:

None

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE SUPPORT EQUIPMENT RECEIVING AREA & SHIPPING CONTAINER STORAGE
(PI OR USER EQUIPMENT)

AREA UTILIZATION SCENARIO:

For receipt, inspection, decrating, and storage
Required in support of PI mission peculiar test equipment and
shipping containers

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Supportive, close proximity, 1st floor area preferred

-AREA DIMENSIONS

50' x 30' with fenced and controllable storage

-CEILING HT

12'

-FLOORING

Solid sealed concrete or vinyl asbestos tile

-WALL SURFACE

Smooth

-ACCESS/DOOR SIZE

8' x 8' or 10' x 10' roll-up door

-FIXED PLACE EQUIPMENT

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE

75°F

-RELATIVE HUMIDITY

40-60 % RH

-CLEANLINESS

Clean

-LIGHTING

75 FC

-NOISE

Standard for area use

UTILITIES

-ELECTRICAL POWER

120 V, 1 Ø, 20 amp, 60 Hz

Others TBD

-GASES

NA

-LIQUIDS

NA

-COMMUNICATIONS

Telephone, paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

NA

SPECIALIZED EQUIPMENT:

Hand trucks, decrating equipment, small hoist (1000 lb. capacity)

OTHER REQUIREMENTS:

Loading/unloading dock

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
LSFE ELECTRICAL SHOP

AREA UTILIZATION SCENARIO:

Repair, fabrication, check out of experiment and support hardware.
Specialized area due to mission unique equipment requiring
specialized services

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to all other areas for efficient utilization of
personnel and real time trouble shooting

-AREA DIMENSIONS

20' x 20' = 400 sq ft

-CEILING HT

10' due to rack height on dolly

• -FLOORING

Vinyl asbestos tile, solid

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

6' x 8'

-FIXED PLACE EQUIPMENT

TBD

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
40-60 % RH

-CLEANLINESS
Visually clean

-LIGHTING
75-85 FC

-NOISE
< 50 decibels

UTILITIES

-ELECTRICAL POWER
120 V, 1 Ø, 20 amp, 60 Hz
120/208 V, 3 Ø, 30 amp, 60 Hz
480 V, 3 Ø, 30 amp, 60 Hz

-GASES
NA

-LIQUIDS
NA

-COMMUNICATIONS
Telephone, paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
NA

SPECIALIZED EQUIPMENT:
TBD

OTHER REQUIREMENTS:
Instrumentation power & grounding

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
LSFE/BONDED STORAGE

AREA UTILIZATION SCENARIO:

Will provide a secure and environmentally controlled area for storage of KSC research support equipment when not required as well as PI equipment. If period between SL-3 and SL-4.

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Proximity should be on the same floor as support labs and the BDCF no further than walking distance, to inhibit unnecessary movement of sensitive equipment

-AREA DIMENSIONS

20' x 20' = 400 sq ft

-CEILING HT

10'

-FLOORING

Vinyl asbestos tile

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

6' x 8'

-FIXED PLACE EQUIPMENT

NA

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE
72-75°F

-RELATIVE HUMIDITY
40-60 % RH

-CLEANLINESS
Visually clean

-LIGHTING
60 FC

-NOISE
Standard for this area

UTILITIES

-ELECTRICAL POWER
120 V, 1 Ø, 30 amp, 60 Hz

-GASES
NA

-LIQUIDS
NA

-COMMUNICATIONS
Paging, others TBD

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
NA

SPECIALIZED EQUIPMENT:
NA

OTHER REQUIREMENTS:
Shelving

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE BASELINE DATA COLLECTION AREAS

AREA UTILIZATION SCENARIO:

Would provide generic areas for installation of PI, mission unique testing apparatus. i.e., acceleration rails, drop platforms, exercise models, etc., and for the execution of protocol required to evaluate various functions before and after flight for comparative analysis. All STS flights will most likely require some form of baseline testing to better evaluate man's ability to perform and acclimate to the space environment and reacclimate to Earth

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to medical exam area and emergency care

-AREA DIMENSIONS

550 sq ft - various dimensions

-CEILING HT

10' & 12'

-FLOORING

Solid $< 5 \times 10^{-3}$ RMS, at 0.5Hz to 5 Hz range vibration. Ground floor preferred with no mechanical noise.

-WALL SURFACE

White, smooth, washable

-ACCESS/DOOR SIZE

6' x 8' & 4' x 8' for equipment and gurney access

-FIXED PLACE EQUIPMENT

TBD, very little

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72°F

-RELATIVE HUMIDITY

40-60 % RH

-CLEANLINESS

Visually clean

-LIGHTING

75-85 FC controllloable dimmers

-NOISE

< 45 decibels

UTILITIES

-ELECTRICAL POWER

120 V, 1 Ø, 20 & 30 amp, 60 Hz

120/208 V, 3 Ø, 30 amp, 60 Hz

480 V, 3 Ø, 50 amp, 60 Hz

-GASES

Stub ups for air and vacuum

-LIQUIDS

Hot & cold H₂O stub-ups

-COMMUNICATIONS

Telephone, paging, 9600 Baud modem, OIS

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Terminal hook-ups to Biomedical CPU as well as RS 232 to user room A & B

SPECIALIZED EQUIPMENT:

Power conditioner

OTHER REQUIREMENTS:

Instrumentation power & grounding

Controllable access

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
LSFE/OFFICE SPACE

AREA UTILIZATION SCENARIO:

Will provide office space for visiting investigators and KSC resident staff

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity required for efficient utilization of personnel and space. Required collocation to clerical and conference area.

-AREA DIMENSIONS

30 PI offices 10' x 10' = 3000 sq ft
15 Resident 10' x 10' = 1500 sq ft
5 Management 12' x 15' = 900 sq ft

-CEILING HT

8' standard

-FLOORING

Vinyl asbestos tile or carpet

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

3' x 7'

-FIXED PLACE EQUIPMENT

NA

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK
LOCATIONS

ENVIRONMENT:

-TEMPERATURE

72°F

-RELATIVE HUMIDITY

40-60 % RH

-CLEANLINESS

Visually clean

-LIGHTING

65-70 FC

-NOISE

< 45 decibels

UTILITIES

-ELECTRICAL POWER

120 V, 1 Ø, 15 amp, 60 Hz

-GASES

NA

-LIQUIDS

NA

-COMMUNICATIONS

Telephone, intercom, paging in area

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

TBD, terminals to CPU

SPECIALIZED EQUIPMENT:

TBD

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE/MICROBIOLOGY AND VIROLOGY LAB

AREA UTILIZATION SCENARIO:

Provide experiment analytical and test subject clinical support

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Should be located in same area as Bio Assay laboratory for more efficient operations. Should be collocated adjacent to PI tissue and culture prep area.

-AREA DIMENSIONS

Clinical Micro	- 15' x 24' = 360
Enviro Micro	- 15' x 24' = 360
Sterilization Room	- 12' x 15' = 180
Wash Room	- 12' x 15' = 180
Media Prep & supply	- 10' x 10' = 100
Microscopy	- 8' x 10' = 80

1440

-CEILING HT

9'- 10'

-FLOORING

Smooth lab (Decotex)

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

4' x 7' & 6' x 7'

-FIXED PLACE EQUIPMENT

Steam/ETO autoclaves, glassware washer, protective hood, others TBD

-LAYOUT - PLEASE ATTACH AND INCLUDE BENCH OR CASE WORK LOCATIONS

ENVIRONMENT:

-TEMPERATURE
70-72°F

-RELATIVE HUMIDITY
40-50 % RH

-CLEANLINESS
100 K

-LIGHTING
75-85 FC

-NOISE
< 50 decibels

UTILITIES

-ELECTRICAL POWER
120 V, 1 ϕ , 20 & 30 amp, 60 Hz
120/208 V, 3 ϕ , 30 amp, 60 Hz

-GASES
LPG, air, vacuum

-LIQUIDS
H₂O (hot & cold with sink)
DI H₂O

-COMMUNICATIONS
Telephone, paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
TBD

SPECIALIZED EQUIPMENT:
TBD

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:
LSFE/GROUND CONTROL LABORATORIES

AREA UTILIZATION SCENARIO:

Areas are required to support during flight synchronous ground control experiments

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to data acquisition and processing room

-AREA DIMENSIONS

2 areas 12' x 20' = 240 sq ft
15' x 20' = 300 sq ft

540 sq ft

-CEILING HT

12'

-FLOORING

Solid/Decotex

-WALL SURFACE

Smooth, washable/epoxy paint

-ACCESS/DOOR SIZE

6' x 8'

-FIXED PLACE EQUIPMENT

None

-LAYOUT

No case work permanently installed

ENVIRONMENT:

-TEMPERATURE

70°F

-RELATIVE HUMIDITY

50 % RH + 5%

-CLEANLINESS

100 K

-LIGHTING

50-100 FC controllable

-NOISE

< 50 decibels

-ELECTRICAL POWER

120 V, 1 Ø, 20 amp, 60 Hz

120/208, 3 Ø, 30 amp, 60 Hz

480 V, 3 Ø, 50 amp, 60 Hz

-GASES

Stubs for compressed air, vac, LP gas

-LIQUIDS

Stubs for H₂O

-COMMUNICATIONS

Telephone with on/off switch

Modem interface for off-center data link wide band capability for video transmission

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Terminal input to Biomed CPU and O&C Room 1263

SPECIALIZED EQUIPMENT:

28 V DC power supply

Power conditioner

OTHER REQUIREMENTS:

Instrumentation grade power & grounding

Emergency & uninterrupted power

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

LSFE/EMERGENCY TREATMENT ROOM

AREA UTILIZATION SCENARIO:

Provide capability for emergency treatment of test subjects should need arise

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Close proximity to all test areas

-AREA DIMENSIONS

15' x 15' = 225 sq ft

-CEILING HT

10'

-FLOORING

Decotex or vinyl asbestos tile

-WALL SURFACE

Smooth, washable (epoxy paint)

-ACCESS/DOOR SIZE

4' x 7' minimum

-FIXED PLACE EQUIPMENT

TBD

-LAYOUT

TBD

ENVIRONMENT:

-TEMPERATURE
70-72°F

-RELATIVE HUMIDITY
50 % RH

-CLEANLINESS
Visually clean

-LIGHTING
Controllable 50-100 FC

-NOISE
< 50 decibels

-ELECTRICAL POWER
120 V, 1 ϕ , 20 amp, 60 Hz
120/208, 3 ϕ , 30 amp, 60 Hz

-GASES
Oxygen

-LIQUIDS
TBD

-COMMUNICATIONS
Telephone, paging

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
NA

SPECIALIZED EQUIPMENT:
TBD

OTHER REQUIREMENTS:

INTRAMURAL RESEARCH FACILITY

(IRF)

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)

MAIN TEST LAB & MONITORED EXERCISE FACILITY CONTAINING COMPUTER
OPS: A MULTIPURPOSE ROOM WITH DESIGNATED AREAS (CONTAIN 9
SUPPLEMENTS)

AREA UTILIZATION SCENARIO:

- 2 treadmill & 1 emergency room located between main test & exercise facility areas
- Computer room separate but centered to 2 room with visual access
- Quiet exam room directly accessible to main lab & lockers
- Separate but in lab area = prep room & anthro room
- Separate but in exer fac = cleaning room & monitoring station

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

-AREA DIMENSIONS

Total 120' x 60'

-CEILING HT

12'

-FLOORING

See each area

-WALL SURFACE

See each

-ACCESS/DOOR SIZE

2 large double door access

-FIXED PLACE EQUIPMENT

TBD

-LAYOUT

TBD

-PLUMBING

TBD

ENVIRONMENT:

- TEMPERATURE
72°F Special controls for computer
- RELATIVE HUMIDITY
< 40 % RH
- CLEANLINESS
Regular
- LIGHTING
Regular - dimming capability
- NOISE
Carpeting - insulation between areas
- ELECTRICAL POWER
110 & 220 plus option of 220 3 Ø power for TMs dedication - avoid irregular
- GASES
Racks, emergency supplies in racks; O₂
- LIQUIDS
Water available for prep & cleaning
- COMMUNICATIONS
General PA system for paging
Special emergency lines
Usual telephone

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

- Important room & access data collection outlets (see attached for room)
- Real time and storage processing

SPECIALIZED EQUIPMENT:

- | | |
|---------------------|-------------------------|
| Treadmills(2) | Washer/Dryer |
| Training Equipment | Exam Facility Equipment |
| Emergency Equipment | Special Weight Scales |

OTHER REQUIREMENTS:

- (Separate area requirements attached)

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)

MAIN LAB SUPPLEMENT 1 - EXERCISE AND TRAINING ROOM

AREA UTILIZATION SCENARIO:

Part of main lab area

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Next to emergency room/TM/main lab/computer station

Cleaning room available

-AREA DIMENSIONS

35' x 50'

-CEILING HT

12'

-FLOORING

Take heavy weights

-WALL SURFACE

Needed for fixing pulley equipment & racks

Cleanable

-ACCESS/DOOR SIZE

Double door access

-FIXED PLACE EQUIPMENT

Storage shelves in monitoring station

-LAYOUT

Monitoring station

Wall & equipment layout depends on equipment

-PLUMBING

TBD

ENVIRONMENT:

-TEMPERATURE

72° F

-RELATIVE HUMIDITY

40-50 % RH

-CLEANLINESS

Regular

-LIGHTING

Regular - dimming capability

-NOISE

Carpeting

-ELECTRICAL POWER

110/220/220 3 Ø

-GASES

None

-LIQUIDS

None

-COMMUNICATIONS

PA system

Telephone

Emergency telephone

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Access terminal

SPECIALIZED EQUIPMENT:

Weight training

Cycle ergometer

Possible treadmills

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
MAIN LAB SUPPLEMENT 2 - CLEANING ROOM

AREA UTILIZATION SCENARIO:

Located in exercise room
Near TMs/emergency room/main lab

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Closed space but access to main test areas

-AREA DIMENSIONS

6' x 10'

-CEILING HT

10'

-FLOORING

Vinyl

-WALL SURFACE

Cleanable

-ACCESS/DOOR SIZE

2 Regular door

-FIXED PLACE EQUIPMENT

Washer/Dryer
Shelves

-LAYOUT

Appliances, sink with drain, drying rack, storage cabinets, shelves

-PLUMBING

Sink, drain

ENVIRONMENT:

-TEMPERATURE
72°

-RELATIVE HUMIDITY
< 40 % RH

-CLEANLINESS
Regular

-LIGHTING
Regular

-NOISE
Sound insulation for washer/dryer

-ELECTRICAL POWER
110/220

-GASES
None

-LIQUIDS
H₂O Clean solvents

-COMMUNICATIONS
None

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
None

SPECIALIZED EQUIPMENT:
Washer/Dryer

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)

MAIN LAB SUPPLEMENT-3 COMPUTER DATA PROCESSING

AREA UTILIZATION SCENARIO:

A glass enclosed room overlooking main lab & exercise facility
Multitask computer with peripheral terminals throughout entire
research facility

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Overlooking main lab & exercise facility

-AREA DIMENSIONS

20' x 40'

-CEILING HT

12'

-FLOORING

Raised floor for wire access

-WALL SURFACE

Glass on 3 sides where overlooking test areas

Regular wall

-ACCESS/DOOR SIZE

1 Double door into hall

2-3 Regular hall doors into test areas

-FIXED PLACE EQUIPMENT

Shelving on 1 wall for equipment & tapes

-LAYOUT

TBD

-PLUMBING

None

ENVIRONMENT:

- TEMPERATURE
Controlled 72°F
- RELATIVE HUMIDITY
< 40 % RH
- CLEANLINESS
Regular
- LIGHTING
Variable Dimmer
- NOISE
Sound insulation from main labs
- ELECTRICAL POWER
110/220/220, 3 Ø
- GASES
None
- LIQUIDS
None
- COMMUNICATIONS
Terminal outputs
Emergency phone
Telephone
PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

- Multi Task system
- Real time capability
- Real time storage with delayed processing

SPECIALIZED EQUIPMENT:

- Computer

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
MAIN LAB SUPPLEMENT-4 EMERGENCY ROOM

AREA UTILIZATION SCENARIO:
In between main lab & exercise facility
Close proximity to TMs

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
In main test area

-AREA DIMENSIONS
10' x 15'

-CEILING HT
8-10'

-FLOORING
Vinyl

-WALL SURFACE
Cleanable

-ACCESS/DOOR SIZE
Double doors

-FIXED PLACE EQUIPMENT
Shelving, exam table

-LAYOUT
TBD

-PLUMBING
None

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
< 40 % RH

-CLEANLINESS
Regular

-LIGHTING
Dimmer capability

-NOISE
Sound suppression insulation

-ELECTRICAL POWER
110/220

-GASES
Racks for emergency air, O₂

-LIQUIDS
Cleanser, solvents, medicines

-COMMUNICATIONS
Emergency telephone
Telephone
PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
None

SPECIALIZED EQUIPMENT:
Emergency support equipment

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)

MAIN LAB SUPPLEMENT-5 TREADMILL ROOMS (2)

AREA UTILIZATION SCENARIO:

Located in main test labs

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Near exercise facility/main lab/ emergency room/computer room

-AREA DIMENSIONS

2 rooms 10' x 15' each

-CEILING HT

12'

-FLOORING

Support TMs

Carpeting

-WALL SURFACE

Cleanable

-ACCESS/DOOR SIZE

Double doors

-FIXED PLACE EQUIPMENT

TMs - computer terminals/monitoring equipment

-LAYOUT

-PLUMBING

None

ENVIRONMENT:

-TEMPERATURE
72⁰F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Regular

-LIGHTING
Dimming capability

-NOISE
Sound insulation

-ELECTRICAL POWER
220, 3 ϕ , 220/110

-GASES
Racks for air tanks

-LIQUIDS
None

-COMMUNICATIONS
PA, telephone, emergency telephone

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

1. Separate terminals
2. Monitoring equipment

SPECIALIZED EQUIPMENT:

TMs
Monitoring equipment

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
MAIN LAB SUPPLEMENT-6 MAIN TEST AREA

AREA UTILIZATION SCENARIO:

Main test facility contains a weight room, prep room & quiet exam rooms (see additional supplements 7-9)

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Next to computer/TMs/emergency room/weight room/prep room/quiet exam rooms. Close to locker rooms.

-AREA DIMENSIONS

35' x 50'

-CEILING HT

12'

-FLOORING

Carpeted

-WALL SURFACE

Cleanable

-ACCESS/DOOR SIZE

Double door to hall

Regular access doors to quiet room, prep, & weight room

-FIXED PLACE EQUIPMENT

Racks for air tanks

-LAYOUT

-PLUMBING

None

ENVIRONMENT:

-TEMPERATURE

72⁰ F

-RELATIVE HUMIDITY

< 40 % RH

-CLEANLINESS

Regular

-LIGHTING

Variable dimmer

-NOISE

Sound insulation

-ELECTRICAL POWER

110/220/220, 3 ϕ

-GASES

Racks for air tanks

-LIQUIDS

None

-COMMUNICATIONS

Emergency telephone, telephone, PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Computer terminal

Monitoring equipment

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)

MAIN LAB SUPPLEMENT 7 WEIGHT/ANTHROPOMETRIC ROOM

AREA UTILIZATION SCENARIO:

Small room with sensitive scale for nude weighing

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Part of main lab

Close to prep room/lockers

-AREA DIMENSIONS

6' x 10'

-CEILING HT

8'

-FLOORING

Vinyl

-WALL SURFACE

Cleanable

-ACCESS/DOOR SIZE

Regular access

-FIXED PLACE EQUIPMENT

Wall hooks, bench

-LAYOUT

-PLUMBING

None

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
< 40 % RH

-CLEANLINESS
Regular

-LIGHTING
Regular

-NOISE
Regular

-ELECTRICAL POWER
110

-GASES
None

-LIQUIDS
None

-COMMUNICATIONS
None

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

None

SPECIALIZED EQUIPMENT:

Specialized, sensitive scale
Anthropometric equipment

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
MAIN LAB SUPPLEMENT-8 PREP ROOM

AREA UTILIZATION SCENARIO:
Part of main test facility

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Near main lab/weight room/quiet exam room/exercise facility/TMs

-AREA DIMENSIONS
10' x 10'

-CEILING HT
8-10'

-FLOORING
Vinyl

-WALL SURFACE
Cleanable

-ACCESS/DOOR SIZE
2 regular access doors

-FIXED PLACE EQUIPMENT
Shelving & cabinets

-LAYOUT

-PLUMBING
Sink

ENVIRONMENT:

-TEMPERATURE
72⁰F

-RELATIVE HUMIDITY
< 40 % RH

-CLEANLINESS
Regular

-LIGHTING
Regular

-NOISE
Regular

-ELECTRICAL POWER
110

-GASES
None

-LIQUIDS
H₂O

-COMMUNICATIONS
None

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
None

SPECIALIZED EQUIPMENT:
None

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)

MAIN LAB SUPPLEMENT-9 EXAM QUIET ROOMS

AREA UTILIZATION SCENARIO:

1 exam room with folding walls so could be total of 4 separate exam rooms

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Near main lab/lockers/prep room/weight room/exercise facility

-AREA DIMENSIONS

Total 20' x 30'

Each 10' x 15'

-CEILING HT

8-10'

-FLOORING

Vinyl

-WALL SURFACE

Cleanable

-ACCESS/DOOR SIZE

Access doors from each of 4 rooms if in that configuration folding walls to make 1 extra large exam room

-FIXED PLACE EQUIPMENT

Shelving, cabinets

-LAYOUT

-PLUMBING

4 sinks

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
< 40 % RH

-CLEANLINESS
Regular

-LIGHTING
Dimmer

-NOISE
Sound insulation

-ELECTRICAL POWER
110/220

-GASES
Racks for air tanks

-LIQUIDS
H₂O, cleaners, medicine

-COMMUNICATIONS
Emergency telephone, telephone, PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
None

SPECIALIZED EQUIPMENT:
Monitoring equipment

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
BIOMEDICAL RESEARCH LABORATORY SPECIAL TEST FACILITIES

AREA UTILIZATION SCENARIO:

Special rooms when can be isolated from other tests acoustically,
light, and RF

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Near back of lab - away from greater noise producing areas

-AREA DIMENSIONS

15' x 15'

-CEILING HT

12'

-FLOORING

Shielded

-WALL SURFACE

Shielded

-ACCESS/DOOR SIZE

Regular

-FIXED PLACE EQUIPMENT

Benches

-LAYOUT

-PLUMBING

None

ENVIRONMENT:

-TEMPERATURE
Controlled 72°F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Regular

-LIGHTING
Variable controlled

-NOISE
Insulated rooms, elec - RF, sound, light

-ELECTRICAL POWER
110/220

-GASES
Limited

-LIQUIDS
Limited

-COMMUNICATIONS
PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Computer terminals

SPECIALIZED EQUIPMENT:
To be determined by task

OTHER REQUIREMENTS:
Special communications - limited PA or control center between rooms
or outside test area

SPECIALIZED LABS
4 Shielded test facilities (elec, sound, light)
Optional Uses: Sensory, reaction time, movement, neuro,
cardiovascular, respiratory, muscularo.

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
H₂O IMMERSION FACILITY

AREA UTILIZATION SCENARIO:

Tank to measure lean body mass
Study fluid shifts

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Located relatively near lockers & main test lab & clinical lab

-AREA DIMENSIONS

15' x 20'

-CEILING HT

12-15'

-FLOORING

Vinyl

-WALL SURFACE

Cleanable

-ACCESS/DOOR SIZE

Double door to hall & to clinical lab

-FIXED PLACE EQUIPMENT

Immersion tank

-LAYOUT

See diagram

-PLUMBING

Heat circulation pump for H₂O tank, drain, overflow

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Regular

-LIGHTING
Regular

-NOISE
Regular

-ELECTRICAL POWER
110/220

-GASES
Limited air tank, O₂, He

-LIQUIDS
H₂O

-COMMUNICATIONS
Emergency telephone, telephone, PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Terminal

SPECIALIZED EQUIPMENT:
Circulating tank at least a 6' x 6' tank

OTHER REQUIREMENTS:
N₂, and/or He analyzer, chair, load cell

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
GLASSWARE CLEANING ROOM

AREA UTILIZATION SCENARIO:
Cleaning & sterilization of all glassware

PHYSICAL:

- INTERRELATIONSHIP TO OTHER AREAS
Access to research & clinical labs

- AREA DIMENSIONS
15' x 20'

- CEILING HT
8-10'

- FLOORING
Vinyl

- WALL SURFACE
Cleanable
Mostly glass covered shelving

- ACCESS/DOOR SIZE
Door access to hall & clinical lab

- FIXED PLACE EQUIPMENT
Sink - drains - autoclave - gas sterilizer - cabinets, shelves

- LAYOUT

- PLUMBING
Sink, autoclave

ENVIRONMENT:

-TEMPERATURE
72⁰F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Regular

-LIGHTING
Regular

-NOISE
Regular

-ELECTRICAL POWER
110/220/220, 3 Ø

-GASES
Limited

-LIQUIDS
H₂O, cleaning solvents

-COMMUNICATIONS
PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
None

SPECIALIZED EQUIPMENT:
Autoclave

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
FLUOROSCOPIC ANALYSIS

AREA UTILIZATION SCENARIO:

A fluoroscope or x-ray capability (OK if already located in clinical or medical areas)

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Access to research, clinical, & medical labs (would need darkroom if x-ray)

-AREA DIMENSIONS

15' x 20'

-CEILING HT

8-10'

-FLOORING

Vinyl

-WALL SURFACE

Shielded for x-rays
Shelving

-ACCESS/DOOR SIZE

To research & clinical labs

-FIXED PLACE EQUIPMENT

Table, fluoroscope, computer enhancement support

-LAYOUT

-PLUMBING

None

ENVIRONMENT:

-TEMPERATURE
72⁰ F

-RELATIVE HUMIDITY
< 40 % RH

-CLEANLINESS
Regular

-LIGHTING
Dimmer capability

-NOISE

-ELECTRICAL POWER
110/220/220, 3 Ø

-GASES

-LIQUIDS
Limited

-COMMUNICATIONS
Emergency telephone, telephone, PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Terminal

SPECIALIZED EQUIPMENT:
Fluoroscope/x-ray
Computers
Table

OTHER REQUIREMENTS:
Dark room - possibly

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
BLOOD GAS CHEMISTRY

AREA UTILIZATION SCENARIO:

For analysis of blood gases, callibration & reliability checks on protocols

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Access to research & clinical labs

-AREA DIMENSIONS
15' x 20'

-CEILING HT
8-10'

-FLOORING
Vinyl

-WALL SURFACE
Mostly shelves & cabinets

-ACCESS/DOOR SIZE
Access to research & clinical labs

-FIXED PLACE EQUIPMENT
Shelves, sink

-LAYOUT

-PLUMBING
Sink

ENVIRONMENT:

-TEMPERATURE
72° F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Regular
Fume hood

-LIGHTING
Regular

-NOISE
Regular

-ELECTRICAL POWER
110/220

-GASES
Limited O₂, N₂, CO, CO₂

-LIQUIDS
H₂O, research solvents

-COMMUNICATIONS
Telephone, PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Terminal

SPECIALIZED EQUIPMENT:
Fume Hood

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
HISTOCHEMISTRY - BIOCHEMISTRY
(TISSUE)

AREA UTILIZATION SCENARIO:
Use for analysis of tissue samples

PHYSICAL:

- INTERRELATIONSHIP TO OTHER AREAS
Access to research & clinical labs

- AREA DIMENSIONS
15' x 20'

- CEILING HT
8-10'

- FLOORING
Vinyl

- WALL SURFACE
Cleanable, mostly shelves & cabinets

- ACCESS/DOOR SIZE
Access doors to research & clinical labs

- FIXED PLACE EQUIPMENT
Shelves, cabinets, sink

- LAYOUT

- PLUMBING
Sink

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Regular - Hood

-LIGHTING
Regular

-NOISE
Regular

-ELECTRICAL POWER
110/220

-GASES
Racks for tanks

-LIQUIDS
H₂O, research chemicals

-COMMUNICATIONS
Telephone, PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Terminal

SPECIALIZED EQUIPMENT:
Hood, suction lines, cryostat

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
GAS PREPARATION ROOM

AREA UTILIZATION SCENARIO:

For calibration of research gases to mix our own gases

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Located near support areas

Access to research & clinical labs

-AREA DIMENSIONS

15' x 20'

-CEILING HT

8-10'

-FLOORING

Vinyl

-WALL SURFACE

Cleanable, shelving, tank racks

-ACCESS/DOOR SIZE

Access doors to hall & chem lab areas

-FIXED PLACE EQUIPMENT

Shelves, tank racks

-LAYOUT

-PLUMBING

None

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Regular

-LIGHTING
Regular

-NOISE
Regular

-ELECTRICAL POWER
110/220

-GASES
Tanks of various kinds including O₂, N₂, CO₂, He

-LIQUIDS
Limited

-COMMUNICATIONS
PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Terminal

SPECIALIZED EQUIPMENT:
Possible compressors or gas mixers

OTHER REQUIREMENTS:
Vacuum lines

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
RECEPTION AREA

AREA UTILIZATION SCENARIO:

Greeting & clearing of personnel entering area - in joint function
with clinical and medical suites
Secretarial & receptionist work area

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
At entrance of research labs

-AREA DIMENSIONS
15' x 20'

-CEILING HT
8'

-FLOORING
Carpeted

-WALL SURFACE
Regular

-ACCESS/DOOR SIZE
Open access to entrance - control access to labs

-FIXED PLACE EQUIPMENT
Cabinets

-LAYOUT

-PLUMBING
None - unless want men's/women's rest rooms in area

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Regular

-LIGHTING
Regular

-NOISE
Regular

-ELECTRICAL POWER
110

-GASES
None

-LIQUIDS
None

-COMMUNICATIONS
Telephone, PA system in control area

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Word processor

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
SECRETARIAL SUPPORT AREA

AREA UTILIZATION SCENARIO:

Processing of paperwork, data, communication, papers, letters, etc.

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Near reception area

-AREA DIMENSIONS
30' x 50'

-CEILING HT
8'

-FLOORING
Carpeting

-WALL SURFACE
Sound muffling

-ACCESS/DOOR SIZE
Access to hall

-FIXED PLACE EQUIPMENT
Files, storage cabinets

-LAYOUT

-PLUMBING
None

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
< 40 % RH

-CLEANLINESS
Regular

-LIGHTING
Regular

-NOISE
Sound insulation for word processing units & printers

-ELECTRICAL POWER
110/220

-GASES
None

-LIQUIDS
None

-COMMUNICATIONS
Word processor, telephone, PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Terminal

SPECIALIZED EQUIPMENT:
WPS

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
LIBRARY - CONFERENCE ROOM

AREA UTILIZATION SCENARIO:

Storage of journals, topic bibliographies, small meeting room

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Near reception area in conjunction with clinical & medical labs

-AREA DIMENSIONS

15' x 20'

-CEILING HT

8'

-FLOORING

Carpet

-WALL SURFACE

Book shelves

-ACCESS/DOOR SIZE

Access to halls

-FIXED PLACE EQUIPMENT

Shelves, screen, slide projector, overhead projector

-LAYOUT

See diagram

-PLUMBING

None

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
< 40 % RH

-CLEANLINESS
Regular

-LIGHTING
Dimming capacity

-NOISE
Sound insulation

-ELECTRICAL POWER
110/220

-CASES
None

-LIQUIDS
None

-COMMUNICATIONS
None

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
None

SPECIALIZED EQUIPMENT:
Projectors, screens

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
STAFF OFFICES

AREA UTILIZATION SCENARIO:

Either large room or series of small 2 desk offices for resident technical staff. Staff includes permanent personnel, aerospace residents, post-doctoral fellows, graduate students, and visiting scientists

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Near reception area, near but not in research labs

-AREA DIMENSIONS

Depends upon projected staff 12' x 15' (2 small desks) each

-CEILING HT

8'

-FLOORING

Vinyl

-WALL SURFACE

Optional - shelves

-ACCESS/DOOR SIZE

Access to hall

-FIXED PLACE EQUIPMENT

Shelves

-LAYOUT

-PLUMBING

None

ENVIRONMENT:

-TEMPERATURE

72° F

-RELATIVE HUMIDITY

< 40 % RH

-CLEANLINESS

Regular

-LIGHTING

Regular

-NOISE

Regular

-ELECTRICAL POWER

110

-GASES

None

-LIQUIDS

None

-COMMUNICATIONS

Telephone, PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

None

SPECIALIZED EQUIPMENT:

None

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
PROFESSIONAL STAFF AND PRINCIPAL INVESTIGATOR STAFF

AREA UTILIZATION SCENARIO:

Offices for prep of papers & work of investigators
Recommend 2 desk offices

PHYSICAL:

- INTERRELATIONSHIP TO OTHER AREAS
Near labs but not in lab, near reception

- AREA DIMENSIONS
15' x 20' each at least 10-12' depending upon projected staff

- CEILING HT
8'

- FLOORING
Vinyl

- WALL SURFACE
Option - shelving

- ACCESS/DOOR SIZE
Access to doors

- FIXED PLACE EQUIPMENT
Shelves

- LAYOUT

- PLUMBING
None

ENVIRONMENT:

-TEMPERATURE

72°F

-RELATIVE HUMIDITY

< 40 % RH

-CLEANLINESS

Regular

-LIGHTING

Regular

-NOISE

Regular

-ELECTRICAL POWER

110

-GASES

None

-LIQUIDS

None

-COMMUNICATIONS

None

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

None

SPECIALIZED EQUIPMENT:

None

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
MEN'S AND WOMEN'S LOCKER ROOMS

AREA UTILIZATION SCENARIO:
For changing & showering

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Located near main test lab/exercise facility/quiet rooms/prep rooms/weight room

-AREA DIMENSIONS

? 20' x 15' each contain 2 sinks, 2 toilets, 2 showers, bench, 4 lockers

-CEILING HT

8-10'

-FLOORING

Tile

-WALL SURFACE

Tile

-ACCESS/DOOR SIZE

To hall to main lab
Regular access

-FIXED PLACE EQUIPMENT

Showers, sinks, toilets, lockers, bench

-LAYOUT

-PLUMBING

Sinks, showers, toilets

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
< 40 % RH

-CLEANLINESS
Regular

-LIGHTING
Regular

-NOISE
Regular

-ELECTRICAL POWER
110

-GASES
None

-LIQUIDS
H₂O

-COMMUNICATIONS
None

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
None

SPECIALIZED EQUIPMENT:
None

OTHER REQUIREMENTS:
None

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
CENTRAL SUPPORT
ELECTRONIC SHOP

AREA UTILIZATION SCENARIO:

For repair, calibration, maintenance, building equipment

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Recommend all support areas located in center of research complex
with ready access to all research areas

-AREA DIMENSIONS

30' x 30'

-CEILING HT

10-12'

-FLOORING

Vinyl

-WALL SURFACE

Mostly shelves & cabinets

-ACCESS/DOOR SIZE

Double door to hall

-FIXED PLACE EQUIPMENT

Benches, cabinets

-LAYOUT

-PLUMBING

None

ENVIRONMENT:

-TEMPERATURE

72°F

-RELATIVE HUMIDITY

< 40 % RH

-CLEANLINESS

Regular

-LIGHTING

Regular - small spot light areas

-NOISE

Sound insulated

-ELECTRICAL POWER

110/220/220, 3 Ø

-GASES

Limited air bottle racks

Air, O₂, CO₂, N₂, He

-LIQUIDS

None

-COMMUNICATIONS

Telephone, PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

None

SPECIALIZED EQUIPMENT:

Necessary test equipment

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE:

CENTRAL SUPPORT
MECHANICAL SHOP

AREA UTILIZATION SCENARIO:

For repair, building, maintenance

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

All support areas together, located in center of research complex
with remote access to all research areas

-AREA DIMENSIONS

30' x 30'

-CEILING HT

12'

-FLOORING

Vinyl

-WALL SURFACE

Cleanable, shelves

-ACCESS/DOOR SIZE

Double door access to hall

-FIXED PLACE EQUIPMENT

Drills, presses, benches, cabinets

-LAYOUT

-PLUMBING

None

ENVIRONMENT:

-TEMPERATURE
72° F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Regular

-LIGHTING
Regular, some spot lighting

-NOISE
Sound insulation

-ELECTRICAL POWER
110/220/220, 3 Ø

-GASES
None

-LIQUIDS
None

-COMMUNICATIONS
Telephone, PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
None

SPECIALIZED EQUIPMENT:
Support equipment

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
CENTRAL SUPPORT
STORE ROOM

AREA UTILIZATION SCENARIO:
Storage of supplies for research complex

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Support areas located together in center of research complex with
ready access to all research areas

-AREA DIMENSIONS
20' x 50'

-CEILING HT
12'

-FLOORING
Vinyl

-WALL SURFACE
Mostly shelving

-ACCESS/DOOR SIZE
Door to hall

-FIXED PLACE EQUIPMENT
Shelves, cabinets

-LAYOUT

-PLUMBING
None

ENVIRONMENT:

-TEMPERATURE
72⁰F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Regular

-LIGHTING
Regular

-NOISE
Regular

-ELECTRICAL POWER
110

-GASES
Air tanks

-LIQUIDS
Cleaners, medicine, solvent stored

-COMMUNICATIONS
Telephone, PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
None

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
CENTRAL SUPPORT
CLEAN ROOM

AREA UTILIZATION SCENARIO:

Processing of space flight hardware checkout

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Support areas located together in center of research complex with remote access to all research areas

-AREA DIMENSIONS

15' x 30'

-CEILING HT

12'

-FLOORING

Vinyl

-WALL SURFACE

Cleanable

-ACCESS/DOOR SIZE

Double door to hall

-FIXED PLACE EQUIPMENT

Benches, shelves, hood

-LAYOUT

-PLUMBING

None

ENVIRONMENT:

-TEMPERATURE

72°F

Controlled air flow

-RELATIVE HUMIDITY

40 % RH

-CLEANLINESS

Controlled air flow - clean room for flight hardware checkout

-LIGHTING

Regular

-NOISE

Regular

-ELECTRICAL POWER

110/220/220, 3 ϕ

-GASES

Limited

-LIQUIDS

None

-COMMUNICATIONS

Telephone, PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Terminal

SPECIALIZED EQUIPMENT:

Hood

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
CENTRAL SUPPORT
EQUIPMENT DEVELOPMENT SHOP

AREA UTILIZATION SCENARIO:

For development and design of research and operational equipment

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Central support areas together collocated with research complex with ready access to all research areas

-AREA DIMENSIONS

20' x 50'

-CEILING HT

12'

-FLOORING

Vinyl

-WALL SURFACE

Mostly shelves

-ACCESS/DOOR SIZE

2 doors to hall

-FIXED PLACE EQUIPMENT

Shelving

-LAYOUT

-PLUMBING

None

ENVIRONMENT:

-TEMPERATURE
72° F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Regular

-LIGHTING
Regular some spot lights

-NOISE
Sound insulation

-ELECTRICAL POWER
110/220/220, 3 Ø

-GASES
Limited

-LIQUIDS
None

-COMMUNICATIONS
Telephone, PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Terminal, monitoring equipment

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
DATA STORAGE LIBRARY

AREA UTILIZATION SCENARIO:

Storage of data - tape library
Work area for data processing

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Relatively near computer room, away from possible electrical or magnetic force (like shop) to protect tapes

-AREA DIMENSIONS

20' x 30'

-CEILING HT

8-10'

-FLOORING

Regular

-WALL SURFACE

Mostly shelves

-ACCESS/DOOR SIZE

Regular access

-FIXED PLACE EQUIPMENT

Shelving

-LAYOUT

-PLUMBING

None

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Regular

-LIGHTING
Regular

-NOISE
Regular

-ELECTRICAL POWER
110/220

-GASES
None

-LIQUIDS
None

-COMMUNICATIONS
Terminal, telephone, PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Terminal, work area

SPECIALIZED EQUIPMENT:
Racks for computer printouts

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
ENVIRONMENTAL CHAMBERS (2)

AREA UTILIZATION SCENARIO:

2 chambers - data collection center between control for temperature
& RH

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREA
In research lab

-AREA DIMENSIONS

Each chamber will contain a TM, bike, bed so about 15' x 15' or 10'
x 20' each
Like size area between

-CEILING HT
12'

-FLOORING
Vinyl

-WALL SURFACE
Cleanable - windows to data area

-ACCESS/DOOR SIZE
Double door access to hall
Air lock entrances to chambers so can go in & out without altering
chamber conditions

-FIXED PLACE EQUIPMENT
TM, wire ports, tube ports

-LAYOUT
See diagram

-PLUMBING
None

ENVIRONMENT:

-TEMPERATURE

Variable control 10°-140°F Chamber
Data room 72°F

-RELATIVE HUMIDITY

Chambers 0-95%
Data room < 40 % RH

-CLEANLINESS

Regular

-LIGHTING

Each area separate control

-NOISE

Chambers enclosed

-ELECTRICAL POWER

110/220

-GASES

O₂, CO₂, N₂

-LIQUIDS

Limited

-COMMUNICATIONS

Emergency telephone, telephone, general PA system, communication PA
into & from chamber

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:

Terminals

Real time monitoring

SPECIALIZED EQUIPMENT:

Chambers, TMs, monitoring equipment

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)
OPEN TEST FACILITY

AREA UTILIZATION SCENARIO:

Large test facility located away from main test area for respiratory motion analysis, particular PI experimental requirements can be altered for current needs

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS
Somewhat away from main test lab
Terminal access

-AREA DIMENSIONS
20' x 40'

-CEILING HT
12'

-FLOORING
Vinyl

-WALL SURFACE
Cleanable

-ACCESS/DOOR SIZE
Double door to hall

-FIXED PLACE EQUIPMENT
Sink, shelving

-LAYOUT
See diagram

-PLUMBING
Sink

ENVIRONMENT:

-TEMPERATURE
72°F

-RELATIVE HUMIDITY
< 40 % RH

-CLEANLINESS
Regular

-LIGHTING
Dimming capability

-NOISE
Sound insulation

-ELECTRICAL POWER
110/220

-GASES
Air tank racks

-LIQUIDS
H₂O Limited

-COMMUNICATIONS
Emergency PA, telephone, PA system

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Terminal

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:

MEDICAL OPS AND RESEARCH SUPPORT

RESEARCH/SUPPORT DISCIPLINE: (IRF)

STAFF LOUNGE - in conjunction with submission of clinical & medical labs

AREA UTILIZATION SCENARIO:

Area for staff to relax, cook, eat

PHYSICAL:

-INTERRELATIONSHIP TO OTHER AREAS

Separate from labs

-AREA DIMENSIONS

15' x 20' including kitchen & lounge area

-CEILING HT

8'-9'

-FLOORING

Vinyl asbestos tile

-WALL SURFACE

Smooth, washable

-ACCESS/DOOR SIZE

3' x 7' or 4' x 7'

-FIXED PLACE EQUIPMENT

Stove, sink, refrigerator, microwave, dishwasher

-LAYOUT

-PLUMBING

As required

ENVIRONMENT:

-TEMPERATURE
12°

-RELATIVE HUMIDITY
40 % RH

-CLEANLINESS
Visually Clean

-LIGHTING
60-75 FC

-NOISE
< 50 decibels

UTILITIES:

-ELECTRICAL POWER
110/220

-GASES

-LIQUIDS
Water

-COMMUNICATIONS
Telephone

DATA COLLECTION AND MAINTENANCE REQUIREMENTS:
Janitorial service

SPECIALIZED EQUIPMENT:

OTHER REQUIREMENTS:
Sofa, chairs & tables in lounge area

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16. Abstract The Space Transportation System (STS) has moved into the operational mode. Emphasis is shifting from the flight testing of the orbiter vehicle to the preparation and flight of the payloads. This shift in emphasis serves as a harbinger of a new era at KSC, one of moving the KSC toward a mature spaceport. An important part of this change is the transition of the medical and life sciences aspects of the STS flight operations to reflect this new state. This report provides an analysis of the medical operations, the life sciences flight experiments support requirements and the intramural research program expected to be at KSC during the operational flight period of the STS and a future space station; compares the adequacy of available facilities, plans, and resources against these future needs; and proposes revisions and/or alternatives where appropriate.					
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